INSECTS OF HAWAII

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A Manual of the Insects of the Hawaiian Islands, including an Enumeration of the Species and Notes on their Origin, Distribution, Hosts, Parasites, etc.

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VOLUME 3

HETEROPTERA

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PREFACE TO VOLUME 3

In this third volume of the series *Insects of Hawaii,* 224 species of Hemiptera–Heteroptera, or true bugs, are listed. This group includes some of the finest and most interesting of Hawaiian insects, and they are, in general, better known than most of the other sections of the endemic Exopterygota. There are, however, many new kinds to be described, and little is known regarding the bionomics of most of the endemic species.

The "Preface to the First Five Volumes" (in volume 1) contains a detailed discussion of this series of volumes and should be consulted for general comment and acknowledgments.

The illustrations for this volume were made mostly by Frieda Abernathy, University of California; Arthur Smith, British Museum (Natural History); and W. Twigg-Smith and J. T. Yamamoto, Experiment Station, H.S.P.A.

Dr. Harry Arnold, Jr., editor of the *Hawaii Medical Journal,* kindly gave permission for the use of the material on *Triatoma.*

I owe many thanks to W. E. China, British Museum (Natural History), for reading the manuscript, for answering many questions, for sending many notes regarding types in the British Museum and for much constructive criticism. My close friend, R. L. Usinger, who has contributed so much to the knowledge of the Heteroptera of Hawaii, naturally has taken a keen interest in this volume, and I have leaned heavily on him for aid and guidance. He has read the manuscript, has answered innumerable questions and has helped me in many ways. My colleague, R. H. Van Zwaluwenburg, Experiment Station, H.S.P.A., read the manuscript and proof for the entire volume. I am deeply indebted to these gentlemen for all they have done to make this volume better.

E.C.Z.

Honolulu,
July, 1948

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Order **HEMIPTERA** Linnaeus, 1758

(*hemi,* half; *ptera,* wings)

Proboscidea Scopoli, 1761.
Ryngota Fabricius, 1775.
Rhynchota Fabricius, 1803.

The order Hemiptera is of ancient lineage, for it was highly developed in the Lower Permian, and although no fossils have yet been found in older strata, it must have been well developed in Carboniferous times, judging from its Permian expansion. Essig (1942:265) estimates that the order contains about 150 families and 48,000 species. Some authors have given equivalent ordinal rank to the two suborders Heteroptera and Homoptera, but the obvious, close affinities of the groups and their continuity of morphological features make such a treatment untenable.

Suborder **HETEROPTERA** Latreille, 1810

(*hetero,* different; *ptera,* wings)

The True Bugs

The following diagnosis will distinguish the Heteroptera from the Homoptera: Fore wings held horizontally and overlapping over the abdomen, usually conspicuously coriaceous at base and membranous distally; rostrum (excepting in the Corixidae) arising anteriorly on head and head with a distinct hypostomal ("neck") region; wingless forms uncommon, but if wingless, with rostrum distinctly arising from the head, not apparently from between the fore coxae.

The suborder Heteroptera is characterized as follows:

Small to large insects of diverse form and structure; usually heavily sclerotized and well pigmented. Head variable, prognathous or hypognathous, usually prognathous, well exposed, usually free; cephalic sutures obscure or obsolete except for the usually distinct epicranial and clypeal sutures; compound eyes large and conspicuous in all our species; a pair of ocelli usually present, but absent in some forms; antennae filiform, long and slender in most forms, four- or five-segmented, free and exposed in all our forms excepting the aquatic series Gymnocerata; mouth parts highly modified and specialized for piercing and for sucking plant or animal fluids (except in the Corixidae, in which group they are modified to enable the bugs to ingest solids such as the contents of algal strands,

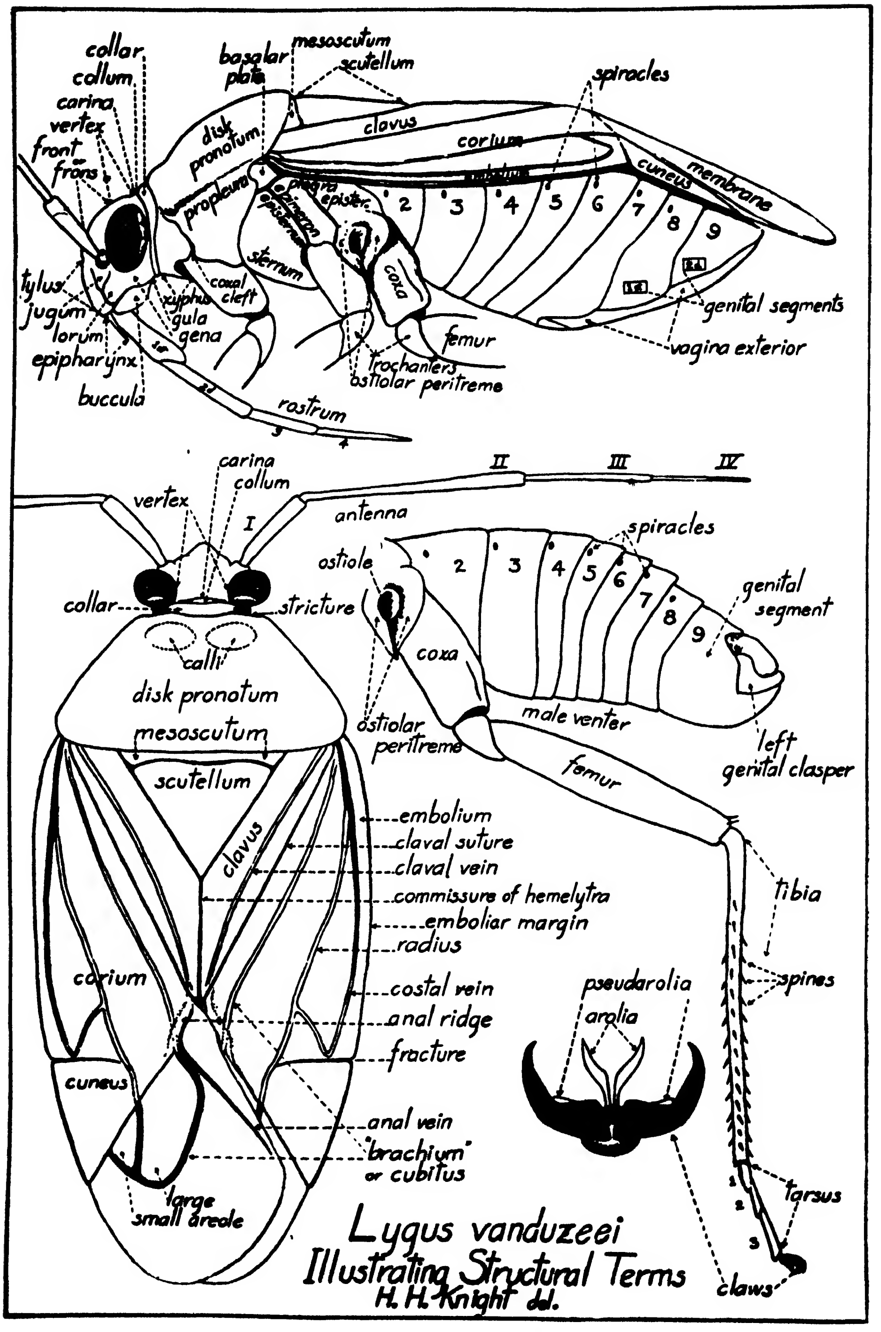


Figure 1—Diagram showing details of a mirid bug. (After Knight, 1917.)

diatoms, etc.), produced into a long, slender, compact rostrum; clypeus, labrum and epipharynx variable, often fused or obscure; labium four-segmented, although it may appear to be only three-segmented because of a shortened first segment, forming the body of the beak or rostrum, grooved to receive the modified, stylet-like mandibles and maxillae which are capable of an in-and-out slipping motion, controlled by muscular action, for piercing the host's tissues; mandibles forming the outer pair of stylets, usually subapically serrated; maxillae forming the inner pair of stylets, sub-W-shaped in cross section, each fitting tightly to the other to form a double-channeled tube, the dorsal duct thus formed is the canal through which the food material is sucked, and the salivary fluids are discharged through the ventral channel; palpi rudimentary or absent; rostrum bent backward under the head or under the head and body (depending upon its length) when at repose, but extending sub-vertically, or sub-horizontally in front of the body when feeding; only the mandibular and maxillary stylets are inserted in the host, the mandibles act as knives and slightly precede the insertion of the suctorial maxillae, the labium acts as a guide but does not penetrate tissues. Thorax with the pronotum usually large and distinct, mesonotum usually highly developed, its scutellum generally large and conspicuous, unusually large in the Scutelleridae and Pentatomidae; metanotum usually reduced. Legs ambulatory, saltatory, or modified for swimming, or raptorial; tarsi one-, two-, or three-segmented, heteromerous in some forms; claws usually apical, preapical in certain aquatic forms only, arolia and empodia present or absent. Wings folded flat and horizontally over back at repose, fully developed, abbreviated or wanting; hind wings membranous, folded beneath the fore pair; anterior wings (called hemelytra) usually thickened and coriaceous basad, and with a smaller membranous apical part, but variable, the basal area usually divided into a narrow inner clavus, and a broad outer corium, the latter may be divided into an outer narrow embolium and a smaller latero-distal cuneus (see illustrations); membrane with or without veins, if veins are present, then with or without closed cells; membrane reduced or absent or coriaceous in some forms, when folded the membrane of one wing overlaps that of the other; venation of both pairs of wings highly modified, especially in the fore pair, veins often obscure. Abdomen basically eleven-segmented, but usually at most only nine or ten segments are distinguishable and only six of these distinct, usually much modified; cerci absent; ovipositor present or reduced or rudimentary, when developed consisting of three pairs of valves and issuing at the base of the true ninth sternite; male with well-developed phallic organs, often with highly modified accessory parts. Metamorphosis gradual. Eggs variformed, diverse in shape, sculpture and kind, laid free, cemented to a substratum, or inserted in plant tissues. Reproduction bisexual. Normally with five nymphal instars, with wing rudiments minute in third instar, distinct in fourth. Principally free-living herbivores, some predators, some bloodsuckers, others obligatory ectoparasites.

The oldest known fossil Heteroptera have been found in Australian Triassic

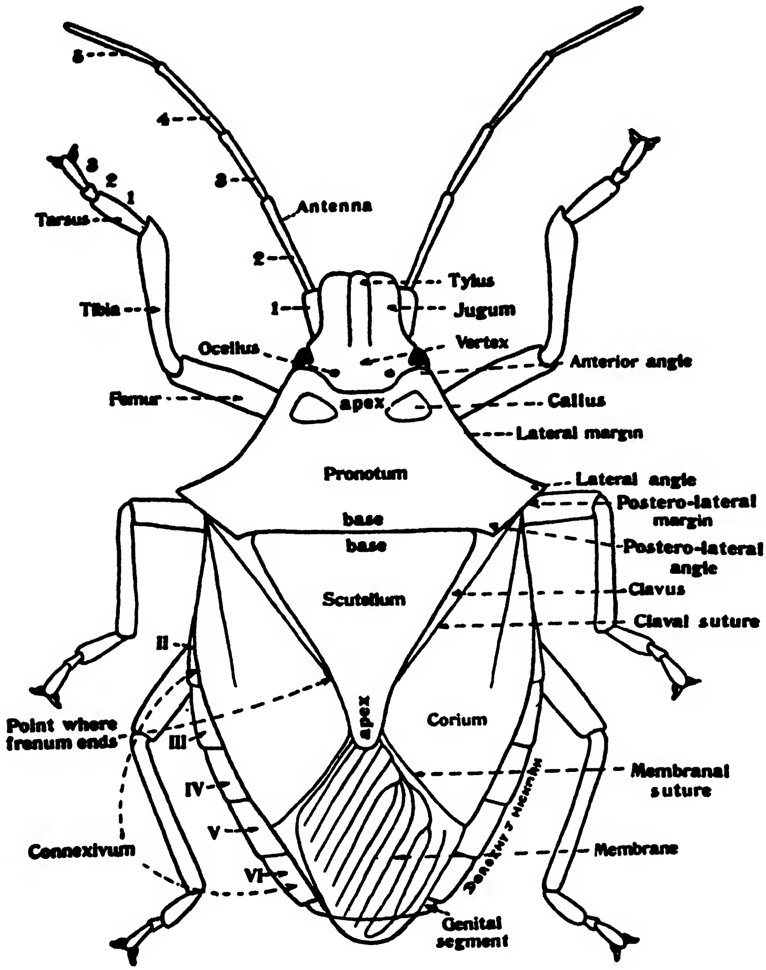


Figure 2—Diagram of features of a pentatomid bug. (After Parshley, 1923.)

formations. Cretaceous and Tertiary fossil Heteroptera are common, widespread and multiform.

Geographically the Heteroptera are perhaps the most widespread of all of the insect orders. They inhabit deserts and subpolar areas, and some are even independent of land, for they are pelagic and live far out on the open oceans.

Heteroptera are found over all our islands from seashore to mountain peaks, and we have representatives of the pelagic *Halobates*. Unlike most orders, native bugs can be found from our beaches to the mountain tops, for some species have been able to adapt themselves to the drastic changes wrought in the lowland flora and fauna since the advent of man.

Here included are 68 genera containing 223 forms known to occur in Hawaii. There are, however, several genera and many species in the collections examined

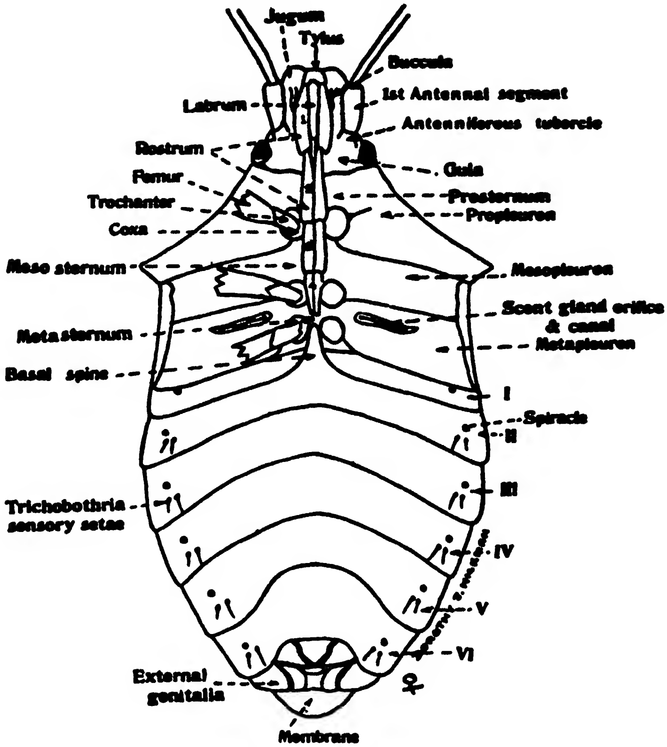


Figure 3—Details of the ventral surface of a pentatomid bug. (After Parshley, 1923.)

which are new or have not been recorded from the Hawaiian Islands. Some groups have proliferated greatly in the archipelago, and the lygaeid *Nysius* complex has a greater development in the Hawaiian Islands than anywhere else. The greatest endemic complexes are in the families Miridae, Lygaeidae and Nabidae.

The first Hawaiian heteropteron to be described was *Oechalia grisea,* which Burmeister described in 1834. W. S. Dallas (1851), C. Stål (1854, 1859, 1870, 1874), F. Buchanan White (1877, 1878, 1881) and Thomas Blackburn (1888) contributed descriptions of new species of Hawaiian bugs before 1900. In 1902, Kirkaldy's paper was published in *Fauna Hawaiiensis,* and this was followed by the supplement in 1910. In 1911 Perkins described some new forms. For more than 30 years the Hawaiian Heteroptera have received little attention except from two workers. E. P. Van Duzee described some new genera and species in 1936, and since that time R. L. Usinger has entered the field and has contributed several noteworthy papers. Usinger has on loan for study a large part of the Heteroptera from local collections, and he intends to revise the entire Hawaiian bug fauna.

Essig (1942:269) recognizes 43 families in the suborder Heteroptera. Of these, only the following 12 families are represented in the native fauna: Scutelleridae (considered a subfamily here), Pentatomidae, Coreidae, Lygaeidae, Enicocephali-

dae, Reduviidae, Ploiariidae (hereinafter fused with the Reduviidae), Nabidae, Anthocoridae, Miridae, Saldidae, and Gerridae. None of the following families gained natural access to Hawaii, although the italicized families are now represented in the islands by immigrant forms which have been imported by the intentional or accidental aid of man: Plataspididae, Podopidae (not considered a family by W. E. China), Cydnidae, *Corizidae* (not considered a family by China), Alydidae (not considered a family by China), Aradidae, Dysodiidae, Termitaphididae, Neididae, Pyrrhocoridae, Piesmidae, Thaumastocoridae, Phymatidae, Polyctenidae, *Cimicidae,* Microphysidae, *Cryptostemmatidae, Hebridae, Mesoveliidae,* Hydrometridae, *Veliidae,* Gelastocoridae, Ochteridae, Naucoridae, Nepidae, Belastomatidae, *Notonectidae,* Pleidae, Helotrephidae and *Corixidae.*

Six of the 12 families represented by endemic species—the Coreidae, Enicocephalidae, Reduviidae, Nabidae, Saldidae and Gerridae — are each represented by a single genus in Hawaii. The Coreidae, Enicocephalidae, Reduviidae and Gerridae each have only one or two endemic species; but *Saldula* of the Saldidae has several species; *Oechalia,* representing the Pentatomidae, has 14 known species; and *Nabis* has a large and diversified assemblage of forms. The Anthocoridae contain six native species in two genera, one of which is a monotypic endemic. Thus, the only families which have a generically complex endemic representation in Hawaii are the Lygaeidae and Miridae. Of these, the Miridae, although now comparatively poorly and inadequately known, is the largest and most diversified group. It is followed by the specifically greatly diversified Orsillini of the Lygaeidae.

According to what I can gather from observations made before 1900, many species of Hawaiian bugs were much more abundant in individuals, and many of them were of much wider local distribution than they are now. The changes wrought by man in these islands have been great, and almost all the native plants and animals have suffered greatly as a consequence. There is no way of guessing how many kinds of lowland bugs have become extinct recently and how many were never collected or described, although living when man arrived in Hawaii. There

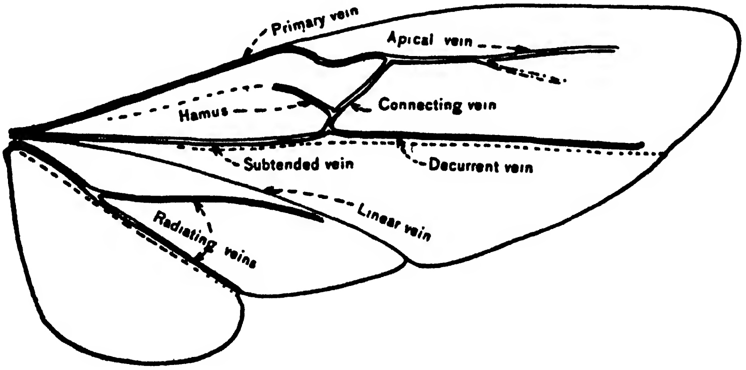


Figure 4—Diagram of the hind wing of a *Nabis* bug to show characters. (After Parshley, 1923.)

are certain exceptions, such as some species of *Nysius,* which have been able to withstand the changing environment and have even taken to introduced plants in the cultivated lowlands in the midst of the areas where introduced predators voraciously forage.

The metamorphosis of the Heteroptera is gradual (paurometabolous) ; the young much resemble the adult stage, excepting principally alary and sexual development. The wings develop from external bud-like pads and are quite evident in the ultimate nymphal instar. There are normally five well-marked nymphal instars between egg and adult, but some workers have reported finding up to eight instars in certain exceptional species. Only a few of our Hawaiian bugs have had their early stages described, and this great field lies open for much-needed and fascinating research.

Records of parental care in the Heteroptera are rare, but there are some authentic published observations. Frost and Haber (1944) have reported that the females of the pentatomid *Meadorus lateralis* (Say) (a United States species) brood over their eggs and first and second instar nymphs. Kirkaldy (1904:577) reviewed the subject for the order.

Many bugs are well known because of their odoriferous or repugnatorial glandular secretions. Some have an obnoxious odor, but, to some people, the odor of certain species is not unpleasant, and it may resemble certain fruits or chemical compounds. Most groups of bugs have well-developed odoriferous glands which open through a pair of metapleural orifices in the adult. A specialized, roughened, evaporating surface often surrounds each orifice, and the secretion is poured out of the orifices and is retained on the modified metapleural areas until it has evaporated. The metapleural orifices are absent on the nymphs, and in their place are some intersegmental orifices on the dorsum of the abdomen. The nymphs of bedbugs (*Cimex*) have the orifices of the "stink glands" on the first three abdominal tergites, and other families have varied arrangements of dorsal abdominal scent glands. The Enicocephalidae have a single median opening on the fourth abdominal segment, the Nabinae have three orifices on the fourth, fifth and sixth segments, but they are wanting in the Ploiariinae and Triatominae. In all groups the dorsal abdominal glands are only developed in the nymphs and become obsolete at adulthood.

There is considerable variation in the development of the wings in the Heteroptera. Brachyptery and pterygo-polymorphism occur both in the endemic and adventive sections of the bug fauna. In the native groups, brachyptery occurs in species of the following families: Lygaeidae, Reduviidae, Nabidae, Anthocoridae, Miridae and Saldidae. The native Gerridae (*Halobates*) are apterous. The only families containing endemic species which do not have brachypterous endemic species are the Pentatomidae and Coreidae. These two families have brachypterous species elsewhere, however. They are represented in our fauna by only three genera containing endemic species.

The Hawaiian Archipelago, in spite of its high rainfall, mountain bogs, swamps

and rushing streams, is without a native aquatic bug fauna. The aquatic series Cryptocerata is represented by not a single native species of any of its several families. The marine *Halobates* are the only representatives of the Gerridae. The semi-aquatic families Hebridae, Mesoveliidae and Veliidae are likewise missing from the native fauna. Single immigrant species of each of the following aquatic and semi-aquatic families, however, have become established in the islands: Hebridae, Mesoveliidae, Veliidae, Notonectidae and Corixidae. (Although the saldids frequent moist places, I have not considered them to represent one of the semi-aquatic families here. The group is well established in the islands.)

The diversity in form and habits of the members of this order is so great that a general description of the group is difficult. The reader is referred, therefore, to the main body of the text for details which will not be outlined here.

The number of noxious species of the order, considered from a world-wide aspect, is large, but we are indeed fortunate in having few harmful forms in Hawaii. New pest species will break through quarantine barriers and become established here as time passes. A few of our species, however, do cause damage of such a serious nature that biological and chemical control is essential. Chemical control utilizes various contact dusts and sprays, some of which are discussed below under the detrimental species.

The bugs may attack man or animals directly, in which case they suck blood, as do the bedbugs and cone-noses. The damage done to plants and food crops is of two major types. The bugs suck the plant juices and thereby reduce the vitality of the plant, or, if the attack is serious enough, it may kill the plants. The injection of salivary fluids may cause harmful toxic effects and result in physiological upsets. Moreover, some species are carriers of plant diseases and diseases of man and animals.

There are a number of insect predators and parasites of the Heteroptera, but only a few are known in Hawaii. The parasites consist mostly of microhymenopterous egg parasites; the predators are most active in their attacks on the nymphal stages of the bugs, although some attack the eggs.

The damage done by certain bug species is partially, at least, balanced by the good contributed by the beneficial kinds. In Hawaii, truly noxious bugs are represented by only a few species included in the families Pentatomidae, Lygaeidae, Reduviidae, Cimicidae and Miridae. However, excepting for a single species, all of our Pentatomidae are predaceous and may be classed as "beneficial," as also may be the entirely or mostly predaceous families Anthocoridae, Nabidae, Hebridae, Mesoveliidae, Veliidae, Saldidae, Notonectidae and Corixidae. But the beneficial contributions of most of these groups are difficult to evaluate and may really have no bearing on man's personal interests. On the other hand, certain species are known to exercise a definite control on noxious insects and are of indisputed value to man. Among these are the *Cyrtorhinus* mirids which have contributed so much to the control of serious leafhopper pests. Some of the anthocorids aid greatly in the control of some small insects. Some of the water bugs may aid in the control of mosquitoes; the tingid *Teleonemia* was purposely imported to aid in the

control of the *Lantana* weed pest; the Nabidae and all except one of the Reduviidae exert an influence which may at times directly aid man; the *Oechalia* pentatomids are known to contribute beneficially because of their attacks on lepidopterous larvae; and some of the other species enter into the roles of beneficial insects, although their actions are generally inconspicuous and unspectacular. In short, there are more beneficial bugs in Hawaii than there are noxious ones.

A large part of the Heteroptera assembled in local collections is on loan to Dr. R. L. Usinger for revisional study. The absence of this material from Honolulu has somewhat handicapped this work, especially because the conditions brought about by the war have made it impossible for either Dr. Usinger or me to examine the collections.

It may not be out of place to call attention here to the proper pronunciation of the name of the great Swedish hemipterist, Carl Stål, whose name appears frequently on the following pages. We hear it pronounced usually as in *hall* or *call,* as *stall;* it should be pronounced as in *hole* or *coal,* as *stole.*

TABULAR ANALYSIS OF THE HAWAIIAN HETEROPTERA

FAMILY	GENERA	ENDEMIC GENERA	NON-ENDEMIC GENERA	SPECIES	ENDEMIC SPECIES	ADVENTIVE SPECIES
Cydnidae	1	0	1	1	0	1
Pentatomidae	3	0	3	16	15	1
Coreidae	2	1	1	3	2	1
Lygaeidae	17	10	7	103	95	8
Tingidae	1	0	1	1	0	1
Enicocephalidae	1	0	1	1	1	0
Reduviidae	6	1	5	9	1	8
Nabidae	1	0	1	26	25	1
Cimicidae	1	0	1	1	0	1
Anthocoridae	8	1	7	12	6	6
Cryptostemmatidae	1	0	1	1	0	1
Miridae	19	9	10	38	29	9
Saldidae	1	0	1	4	4	0
Hebridae	1	0	1	1	0	1
Mesoveliidae	1	0	1	1	0	1
Veliidae	1	0	1	1	0	1
Gerridae	1	0	1	2	2	0
Notonectidae	1	0	1	1	0	1
Corixidae	1	0	1	1	0	1
Totals	68	22	46	223	180	43

Percentage of endemism in native group: genera, 67.2 percent; species, 99.4 percent (0.6 percent indigenous; one of the two gerrids is indigenous).
Percentage of present-day fauna native: 80.7 percent.
Percentage of present-day fauna adventive: 19.3 percent.
Average number of species per genus in native group: 5.4.
Average number of species per genus in adventive group: 1.1.

The average number of species per genus in the native group (5.4) is really greater, because a large number of endemic species are known to us but are undescribed.

Key to the Families of Heteroptera Found in Hawaii

1. Antennae concealed from above, shorter than head; all aquatic forms; series **Cryptocerata** *2*
   Antennae exposed and conspicuous from above, as long as or longer than head; terrestrial and semi-aquatic forms; series **Gymnocerata** 3

2(1). Fore tarsi one-segmented, without claws; head overlapping pronotum above; body not strongly convex above; scutellum hidden; eyes widely separated (water boatmen) .... **Corixidae.**
   Fore tarsi two-segmented, each fore tarsus with two claws; prothorax overlapping head above; body strongly convex dorsally; scutellum visible; eyes large, occupying most of front of head, narrowly separated along median line (back swimmers) ....**Notonectidae.**

3(1). Claws of at least fore tarsi preapical; aquatic forms with ventrites densely clothed with silvery pubescence........ 4
   Claws of all tarsi terminal; ventrites devoid of dense silvery pubescence and not aquatic forms excepting Mesoveliidae and Hebridae, which have silvery pubescence and which are semi-aquatic.......................... 5

4(3). Hind femora extending almost their entire lengths beyond apex of abdomen; thoracic scent gland opening at middle of metasternum; our species marine (water striders).. .... **Gerridae.**
   Hind femora extending only a short distance beyond apex of abdomen; thoracic scent gland openings lateral; fresh-water species (broad-shouldered or smaller water striders) ....**Veliidae.**

5(3). Ventrites clothed with dense silvery pubescence; semi-aquatic species less than 4 mm. in length with both clavus and membrane membranous and without veins.......... 6
   Ventrites without dense silvery pubescence; terrestrial forms *7*

6(5). First two antennal segments together not as long as head; tarsi two-segmented, first segment minute and obscure; hind tibiae shorter than length of head and pronotum combined (velvet water bugs) ....**Hebridae.**
   First antennal segment much longer than head; tarsi three-segmented, first segment minute; legs elongate, hind tibiae longer than head and pronotum combined (water treaders) .... **Mesoveliidae.**

7(5). Scutellum greatly enlarged, extending at least onto membranous part of hemelytra and nearly or to apex of abdomen 8
   Scutellum much smaller, never reaching onto membrane of hemelytra (do not confuse pronotum of Tingidae with scutellum, which is hidden by pronotum)..........10

8(7). Scutellum reaching apex of abdomen, concealing membranous parts of hemelytra (shield bugs) .... **Scutellerinae** of the **Pentatomidae.**
Scutellum not reaching apex of hemelytra, but slightly encroaching upon membranous parts of hemelytra which are exposed 9

9(8). Tibiae hairy but not spinose (stink bugs) ...... **Pentatomidae.**
Tibiae closely set with long, coarse, strong spines; small black species (burrower bugs) .... **Cydnidae.**

10(7). Head subcylindrical; front legs raptorial; base of rostrum usually thickened and curved and not held in contact with underside of head when at rest; head without a ventral groove for reception of rostrum; or unusually large species about three-fourths of an inch long (*Triatoma*) 11
Head not cylindrical; fore legs not raptorial; first segment of rostrum straight or nearly so and usually, but not always (see Saldidae), received in a groove on underside of head or held in contact with underside of head when at rest; or with eyes very large and a pair of ocelli situated near median line of head (Saldidae); species never as large as *Triatoma* 14

11(10). Pronotum with two transverse constrictions and appearing tripartite; head constricted behind eyes and also near base, swollen between constrictions, ocelli situated on the swollen lobe (gnat bugs, unique-headed bugs) .... **Enicocephalidae.**
Pronotum not divided into three lobes (only two lobes or none); head not so formed 12

12(11). Small to minute species; hemelytra with a distinct fracture and cuneus and a distinct embolium...part of **Anthocoridae.**
Medium- to large-sized species; hemelytra without a fracture and without an embolium or cuneus 13

13(12). Prosternum with a specialized, longitudinal, median, transversely minutely striated stridulatory groove between and before the coxae in which rests apex of rostrum; rostrum three-segmented (reduviids) .... **Reduviidae.**
Prosternum without such a specialized groove; rostrum four-segmented (nabids) .... **Nabidae.**

14(10). Ocelli absent 15
Ocelli present (check carefully; they are nearly merged with eyes in Cryptostemmatidae) 19

15(14). Ovoid, flattened, flightless ectoparasites; hemelytra reduced to small pads without a trace of membrane (bedbugs) .... **Cimicidae.**
Not such insects 16

16(15). Hemelytra with conspicuous net-like or lace-like sculpturing; cuneus absent, and membrane without looped

veins; pronotum with elevated, reticulated keels and produced backward and partially or entirely concealing scutellum (lace bugs) .... **Tingidae.**

Without such net-like sculpturing; scutellum exposed; pronotum not extended posteriorly 17

17(16). Hemelytra with a distinct fracture on outer posterior side of corium, thus forming a distinct cuneus (see fig. 1) (plant bugs) .... **Miridae.**

Hemelytra with outer margin entire, without a fracture or cuneus 18

18(17). Fore femora swollen, spinulose beneath; wing membrane with four unlooped veins...... *Tempyra,* part of **Lygaeidae.**

Fore femora not swollen, unarmed; wing membrane with a looped vein or two............ *Sulamita,* part of **Miridae.**

19(14). Ocelli located close together near median line of head and about opposite middle of eyes (shore bugs) .... **Saldidae.**

Ocelli located on or behind a line drawn between posterior margins of eyes, or, if not in such a position, then widely separated and not as above.......................... 20

20(19). Rostrum three-segmented; head without bucculae; abdomen without trichobothria (hair-bearing spots on venter) 21

Rostrum four-segmented; head with well-developed bucculae; abdomen without trichobothria................. 22

21(20). Metasternal scent gland orifices present; cuneus present (flower bugs) .... **Anthocoridae.**

Metasternal scent gland orifices absent; cuneus absent (our species small, soft-bodied bugs, less than 2 mm. long; ocelli nearly merged with eyes; fore wings semimembranous throughout, divergent behind and partially setose) (jumping ground bugs) .... **Cryptostemmatidae.**

22(20). Membrane with numerous, usually more or less anastomosing, veins (squash bugs) .... **Coreidae.**

Membrane with five or fewer veins usually arising from base 23

23(22). Rostrum four-segmented, reaching behind fore coxae in most forms, if not attaining fore coxae then never with a stridulatory groove on prosternum; fore tibiae without a specialized apical pad-like structure on inner side (none of our species more than 10 mm. long) (chinch bugs) .... **Lygaeidae.**

Rostrum three-segmented, not reaching fore coxae; prosternum with a conspicuous, longitudinal, transversely striated, stridulatory groove; fore tibiae with a specialized flap- or pad-like structure on inner side of apex (length 15–20 mm. in our species) .... *Triatoma,* part of **Reduviidae.**

Series I—GYMNOCERATA Fieber, 1861

This is the largest group of the Heteroptera, and it contains all the Hawaiian species excepting the aquatic water boatmen (Corixidae) and the back swimmers (Notonectidae). All the species have the antennae exposed and longer than the head.

Family **CYDNIDAE** (Billberg, 1820) Fieber, 1861

Thyreocoridae, in Fauna Hawaiiensis, in part.

Subfamily CYDNINAE (Dallas)

Burrower Bugs, Ground Bugs, Negro Bugs

Small or medium-sized, black, beetle-like bugs of burrowing or soil or ground-litter-frequenting habit. Antennae five-segmented. Rostrum four-segmented. Two ocelli present. Scutellum long and triangular, reaching the wing membrane. Corium large, heavily sclerotized; membrane reaching apex of abdomen, its veins simple. Tibiae coarsely spinose; tarsi three-segmented.

This family is allied to the Pentatomidae, from which group it can be distinguished easily because of its spiny legs.

Figure 5—*Geotomus pygmaeus* (Dallas), the oceanic burrower bug. (After Williams, 1931.)

Genus **GEOTOMUS** Mulsant and Rey, 1866

Genotype: *Cydnus punctatus* Costa, fixed by Distant.

This is a widespread genus, one species of which has accidentally been imported to Hawaii.

Geotomus pygmaeus (Dallas) (fig. 5).

Aethus pygmaeus Dallas, 1851:120.

Geotomus subtristis White, 1877:110.

Geotomus jucundus White, 1877:111 (Kirkaldy, 1904:179, says that the type has been lost).

Blackburn (1888:344) synonymized White's two names; see China (1930:89) for additional synonymy.

The oceanic burrower bug.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii.

Immigrant. A widespread species which was originally described from India and which has been transported by commerce to most of the islands of Oceania. It has long been in Hawaii and was collected by Blackburn.

This shiny black, spiny-legged species is a common and widespread insect in the islands and may be found in numbers, often in colonies, about the bases of plants and in humus and loose earth. I have found the insects feeding in abundance at the roots of the grass *Paspalum fimbriatum*, and they are commonly taken under such objects as boards, stones and cow chips lying on the ground. When disturbed, they release a strong, odoriferous substance. The "pale variety" applies either to the nymphs or to teneral specimens which are brown. They frequently come to light, especially on warm, still, damp nights. The imported toad, *Bufo marinus*, eats quantities of them.

It would be of interest if some student were to work out the complete bionomics of this species.

Family **PENTATOMIDAE** (Leach, 1815) Samouelle, 1819

Shield Bugs, Stink Bugs

Our most bulky native bugs belong to this family, which contains many large, showy species the world over. The families Scutelleridae and Pentatomidae of some authors are treated herein as subfamilies, following the expert and valued opinion of W. E. China. The usual distinction between the families, based upon the length of the scutellum, works well in some localities, but it does not hold for

the Pentatomidae of the world. Some Pentatominae have a large scutellum which extends to the apex of the abdomen and might be placed in the Scutellerinae if this character alone were used to separate them. However, in Hawaii those species having a large scutellum which extends to the apex of the abdomen and conceals the membranous parts of the hemelytra belong to the Scutellerinae, and all our Pentatominae have a shorter scutellum which does not reach the apex of the hemelytra and encroaches only slightly upon the membranous parts of the wings which are exposed, and we can use these characters for the separation of our species.

Subfamily SCUTELLERINAE

Scutelleridae, of authors.

Thyreocoridae, in Fauna Hawaiiensis, in part.

The Shield Bugs

The scutellum in this group is unusually large; it reaches the apex of the abdomen and completely conceals the membranous parts of the wings in our species. The subfamily can be distinguished from the Pentatominae in Hawaii at a glance, because of the large shield-like scutellum. Some workers consider this group to be a family distinct from the Pentatomidae.

Genus **COLEOTICHUS** White, 1839

This genus is widespread in Oceania and contains many large and elegant bugs.

Coleotichus blackburniae White (figs. 6, 7).

Coleotichus blackburniae White, 1881:52.

Kirkaldy, 1902:172, pl. 5, fig. 49; 1907:144–145, early stages.

The koa bug.

Endemic. Kauai, Oahu (type locality: near Honolulu), Molokai, Lanai, Maui, Hawaii.

Hostplants: feeds principally on the pods and seeds (and evidently even on dried but moist pods) of *Acacia koa*; also on some other species of *Acacia* and on *Dodonaea*.

This magnificent bug is by far the most spectacular of the Hawaiian Heteroptera. It is about three-fourths of an inch long and is the most bulky and most brilliantly colored of all our native bugs (it is exceeded in length in Hawaii only by the immigrant *Triatoma*). There are three principal color phases, the most common of which is predominantly brilliant green above with red markings; the colors of the

next most abundant color phase are reversed in dominance; the third form, which may be attached to *Dodonaea,* has considerable yellow coloring. Some specimens are almost entirely green, others almost entirely red above, and some appear to have an iridescent "frosting." The bug is often found in large colonies on *Acacia koa,* and occasionally it is found on koa trees in the city of Honolulu, but it is now really a forest insect. However, in the early days it was found even in hot and dry localities near sea level and to five or six thousand feet in the mountains (see Perkins, 1913:cxcii).

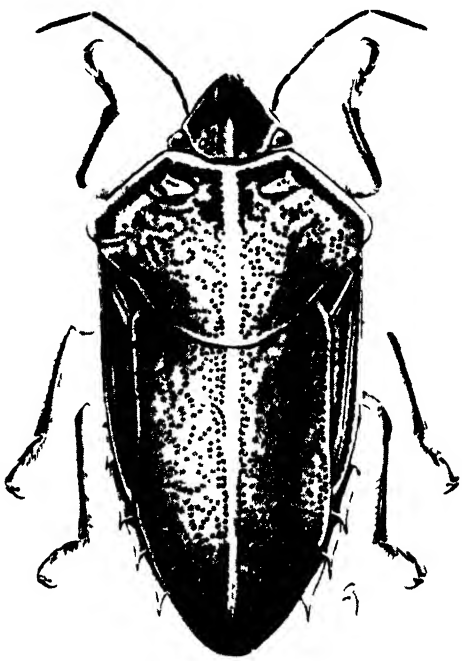


Figure 6—*Coleotichus blackburniae* White, the koa bug. (Abernathy drawing.)

Both adults and nymphs are frequently gregarious, lying packed close together, when at rest. Great numbers are sometimes in consequence found together, and a single tree may hold some hundreds of specimens of adults and nymphs of all sizes, as well as many eggs. The adults appear to be on the wing at night, and occasionally enter houses, attracted by the light. However, they take flight very readily on slight disturbance in the daytime, especially during hot sunshine, usually flying a short distance, and making a loud humming noise as they fly. Sometimes after a short circular flight they return to the tree from which they were disturbed. They are very partial to Koa trees (*Acacia koa*), but feed, so far as I have observed, only upon the pods of these, extracting their juices. Whether they will attack other parts in the absence of pods is very doubtful. They breed likewise very freely on a very different tree, *Dodonaea viscosa,* and both eggs and nymphs are occasionally found on other plants. The two mentioned trees are, however, their favourite food-plants. They have also been found breeding on imported Acacias. Usually from *Dodonaea viscosa* I have obtained the yellow form, with clear yellow dorsal stripe, untinged with red, from *Acacia koa* the red form. Whether these varieties depend entirely on the food-plant is, however, uncertain; it is perhaps more likely

due to climate, the yellow variety being chiefly found in the driest localities. It is a remarkable fact that the little Lycaenid butterfly, *Lycaena blackburni*, which holds a position in the Hawaiian Lepidopterous fauna somewhat analogous to that of *Oechalia* [error for *Coleotichus*. E.C.Z.] in the Heteroptera, feeds either in the pods of *Acacia koa*, or on the *Dodonaea* with equal readiness and, so far as is known, on no other native trees. The small, globular nymphs of the first stage are very conspicuous objects from the strong contrast of their colours, the abdomen being for the most part bright red. (Perkins, 1913: cxcii–cxciii.)

Figure 7—*Coleotichus blackburniae* White, the koa bug.

The golden-green or creamy-white eggs are minutely granular and not conspicuously sculptured. They are usually deposited in groups on the pseudo-leaves of *Acacia koa*. The nymphs are marked with red and black and dark blue. When disturbed the adults fly swiftly away with a loud buzzing sound and do not feign death as do the species of *Oechalia*.

This beautiful insect was named for Mrs. Blackburn, the wife of Reverend Thomas Blackburn, pioneer Hawaiian entomologist.

Subfamily PENTATOMINAE (Leach, 1815)

Cimicidae, in Fauna Hawaiiensis.

The Stink Bugs

Antennae five-segmented; rostrum four-segmented; two ocelli present. The large scutellum reaches the wing membrane, the corium is large and heavily sclerotized; the membrane reaches the apex of the abdomen and has several veins, some of which are forked. The tarsi are three-segmented in our species.

This family obtains its common name from the fact that the bugs can exude a strong musk which is unpleasant to the taste and smell. In some places certain species befoul such fruits as berries with their obnoxious odor. The group is cosmopolitan in distribution and is second only to the Miridae in the number of described species. Our native fauna, however, contains only a single genus. Most of the species are plant feeders and in many places in the world there are important plant crop pests in this family. One of these pests has become established in Hawaii. In the western Pacific, as in the tropical and subtropical regions of the Orient, America and Africa, the family has many extraordinary and beautiful members. The group reaches its greatest development in the Oriental regions. The highly decorated eggs are objects of beauty themselves, and are possibly the most ornate of all insect eggs. (See Esselbaugh, 1946, for a study of the eggs of a number of species.)

Key to the Tribes Found in Hawaii

1. Ventrite two unarmed............................**Pentatomini.**
2. Ventrite two (apparently ventrite one) with a large, conspicuous spine projecting forward between the coxae.......**Asopini.**

Tribe PENTATOMINI (Stål, 1864)

This tribe is represented in our fauna by one accidentally introduced species.

Genus MURGANTIA Stål, 1862

The headquarters of this genus is in South America.

Murgantia histrionica (Hahn) (figs. 8, 9).
Strachia histrionica Hahn, 1834:116, pl. 45, fig. 196.

The harlequin cabbage bug.

Kauai, Oahu.

Immigrant. A native of Central America. First found in the Hawaiian Islands by Swezey at Ewa Coral Plain, Oahu, in 1924. Ehrhorn intercepted the species in quarantine at Honolulu in furniture packing material in 1917 or 1918. First taken on Kauai by S. Au in 1942 at Koloa.

Hostplants: broccoli, *Capparis sandwichiana*, cauliflower, Chinese cabbage, head cabbage, nasturtium.

Parasite: *Ooencyrtus johnsoni* (Howard) (Hymenoptera: Encyrtidae), purposely introduced from the United States.

This species has not become the pest of crucifers in Hawaii that it has in North

America, where its ravages attain serious proportions, but it is gradually spreading here and may become of more importance in the future. It was confined to *Capparis* on Ewa Coral Plain for many years, but it has recently extended its range and has begun to show up in gardens.

This bug is about three-eighths of an inch long when adult and is strikingly colored black and orange. The large eggs are cylindrical and resemble small barrels. They are white with conspicuous black rings, and a single small black spot

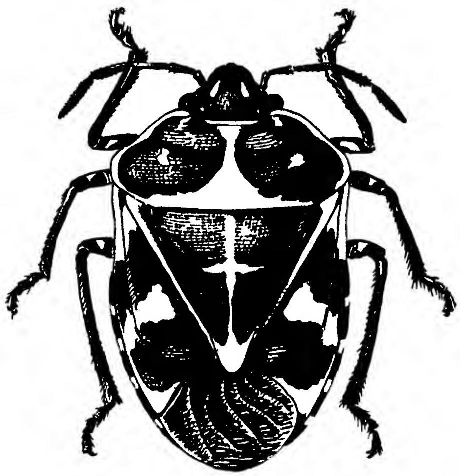


Figure 8—*Murgantia histrionica* (Hahn), the harlequin cabbage bug. (Abernathy drawing.)

resembling a bunghole is situated on the lower ring. Usually about a dozen eggs are laid on the under surfaces of the leaves, somtimes in two parallel rows of six eggs each. Each female may lay several such batches. The nymphs are colored black and orange or red. There are, as usual, five nymphal instars; the nymphs have only four antennal segments instead of the adult complement of five. The complete bionomics have not yet been reported on in Hawaii. Perhaps the entire life cycle may be passed within six to eight weeks here.

The feeding of these insects causes white blotches to appear on the leaves, and the plants may wither and die if severely attacked.

Control: The following methods of control have been recommended by the United States Department of Agriculture (1940):

Practice clean cultural methods throughout the season. Disk and plow under all stalks and other refuse as soon as the crop has been harvested. The growing of trap crops, hand picking, and the use of the blow torch are also effective methods of keeping down the number of bugs.

Control by insecticides is recommended only after preventive measures to reduce the numbers of the insects have been followed.

Spray or dust with derris or cube.

Use 1½ pounds of derris or cube root powder (containing 4 percent of rotenone) with a spreader and wetting agent in 50 gallons of water; or, in smaller quantities, 1½ ounces (10 level tablespoonfuls) with a spreader and wetting agent in 3 gallons of water.

For dusting, use a derris or cube dust containing 0.75 percent of rotenone To prepare this dust, use 15 ounces of finely ground root (having a 4-percent rotenone content) to 4 pounds and 1 ounce of the diluent (finely ground talc, clay, sulfur, tobacco, or other powder except lime), or 18¾ pounds of the root to 81¼ pounds of the diluent. If the rotenone content of the derris or cube is greater or less than 4 percent, the proportions of the inert diluent must be varied accordingly.

Begin spraying or dusting when the bugs first appear and repeat the treatments as often as necessary.

See also White and Brannon, 1939:1–10, figs. 1–6.

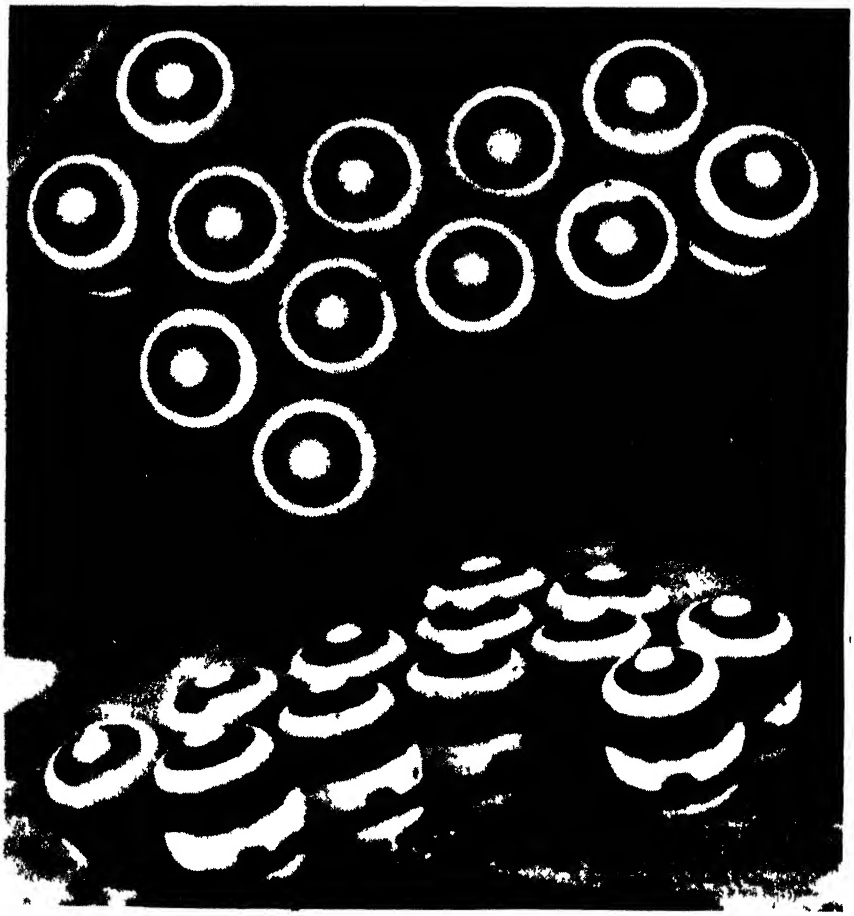


Figure 9—Two views of a cluster of the black-and-white eggs of the harlequin cabbage bug, *Murgantia histrionica* (Hahn), on a cauliflower leaf.

Tribe ASOPINI (Spinola, 1850)

In contrast to the plant-feeding habits of most of the pentatomids, the members of this tribe are predaceous on insects such as caterpillars and aphids and other Homoptera. They are, therefore, beneficial insects.

Genus **OECHALIA** Stål, 1862

Redescription and monograph by Usinger, 1941:59.

This peculiar genus contains 15 species, 14 of which are found in Hawaii and one which is widespread from Australia to southeastern Polynesia. The genus has been in a state of chaos for many years, and most of the literature of the present century is in a sad state of confusion. However, Usinger (1941:59) has published recently a monograph of the genus with detailed descriptions and noteworthy discussion, and he has straightened out the group in a scholarly manner.

The extra-Hawaiian species and genotype, *Oechalia consocialis* (Boisduval), has a few characters which differ from all the Hawaiian species, and Kirkaldy (1909) separated the Hawaiian species from it subgenerically.

Subgenus **Hawaiicola** Kirkaldy, 1909:83

This subgenus is separated from *Oechalia, sensu stricto,* because it has a well-developed lobe on either side of the prosternum instead of feebly developed lobes, and the spine of the second abdominal segment extends beyond the middle coxae instead of reaching only between them.

Figure 10—An egg of an *Oechalia* after the emergence of the nymph. (After Kirkaldy, 1907.)

The species of this group are fast flyers, but they usually remain quiet, drop off the hostplant or feign death if disturbed. However, they sometimes "buzz" about with great speed in one's net. They are among the finest of our native bugs, some species are not uncommon and they are a beneficial group. They are true forest insects, but now and again specimens may wander into the lowlands;

Perkins reported that in his time certain species were common in the lowlands where there was green vegetation. However, the species have become much rarer since Perkins was here. During the time when the sugarcane leafhopper was abundant and doing serious damage, at least one of the species of *Oechalia* (*kaonohi*) invaded some of the sugarcane fields to prey upon the leafhoppers. They attack fairly large caterpillars, such as leaf rollers and loopers, and it is interesting to watch them impale a caterpillar on their outstretched beaks, lift its carcass or carry it about and then discard its withered remains after its juices are sucked out. *Scotorythra, Plusia* and various other pyralid and geometrid caterpillars evidently form the principal food supply of the genus.

The types of *kaonohi* Kirkaldy, *hirtipes* Van Duzee and *virgula* Van Duzee, as well as all of Usinger's types, excepting *sinuata* which is in the U. S. National Museum, are in Honolulu. Stål's types of *patruelis* and *pacifica* and Burmeister's *grisea* are in Europe.

Figure 11—*Oechalia pacifica* (Stål): caudal view of male genital capsule showing the genital plates (**G.P.**), harpagones (**HARP.**) and proctiger (**PROCT.**). (After Usinger, 1941)

Key to the Hawaiian Species of Oechalia

(Recast from Usinger, 1941:72–73)

1. Humeri strongly produced into straight or slightly sinuate, acute or subacute, spines which extend about one-eighth of total width of pronotum beyond bases of hemelytra.... 2
   Humeri only briefly, roundly or subangulately produced, extending one-eleventh or less of total width of pronotum beyond bases of hemelytra...................... 8

2(1). Ground color ferrugineous, marked with usual fuscous to black punctures and with scutellum pale at apex; legs densely clothed with long, erect hairs, those of femora about two-thirds as long as thickness of femora; abdominal spine reaching middle of mesosternum, tapering and subrounded at apex and bent feebly downward apically; genital plates less than one-third width of capsule; harpagones feebly dilated apically, width across tips of arms three-fifths as great as that of genital plate; Hawaii ....**hirtipes** Van Duzee.
   Ground color never distinctly ferrugineous; hairs of legs shorter or less dense 3

3(2). Upper surface distinctly tinged with green; abdominal spine reaching middle of mesosternum, tapering, rounded at apex and bent downward; genital plates less than one-third width of capsule; harpagonal arms well developed, especially ectal one; width across arms three-fourths that of genital plates; Kauai .... **virescens** Usinger.

Upper surface never tinged with green 4

4(3). Legs usually red; abdominal spine very long and slender, nearly reaching front coxae, bent downward toward apex; genital plates large, one-third width of genital capsule; harpagonal arms feebly produced, width across arms one-half to two-thirds that of genital plates; Oahu .... **patruelis** (Stål).

Legs ochraceous or fulvous; male terminalia not so formed.. 5

5(4). General coloration usually appearing as pale brown because of extensive ochraceous ground color and fuscous punctures; genital plates a little less than one-third as wide as capsule; harpagonal arms strongly produced, four-fifths as wide across apices as width of genital plates; Kauai and Oahu .... **grisea** (Burmeister).

General coloration usually darker; harpagones less strongly dilated apically; Hawaii 6

6(5). Humeral angles strongly sinuate; genital plates large, a little more than one-third as wide as capsule; harpagones asymmetrical, ectal arms entirely wanting and width at apex only one-third that of genital plates; Hawaii...... .... **virgula** Van Duzee.

Humeral angles less strongly sinuate or straight; genital plates relatively smaller and harpagones more symmetrical 7

7(6). Upper surface with extensive dark areas; humeri straight; abdominal spine relatively short, almost reaching middle of mesosternum; size relatively large, 11.5 to 12 mm.; genital plates less than one-third as wide as capsule; harpagonal arms moderately produced, two-thirds as wide across apices as width of genital plates; slopes of Mauna Loa, Hawaii .... **acuta** Usinger.

Upper surface with less extensive dark areas; humeri feebly sinuate; abdominal spine long and slender, reaching front coxae; size smaller, 9.5 to 11 mm.; genital plates less than one-third as wide as capsule; harpagonal arms about two-thirds as wide across apices as width of capsule; slopes of Mauna Kea, Hawaii..... **bryani** Usinger.

8(1). Body long and slender, nearly two and one-half times as long as broad, 11:4.5; pronotum relatively narrow, humeri extending only about 1/32 of total width of pronotum beyond bases of hemelytra, little more than twice as broad across humeri as long, 95:45; abdominal spine reaching a little beyond middle of mesosternum, nearly

straight, apex angulate at least dorsally; genital plates slightly more than two-thirds as wide as capsule; harpagonal arms strongly asymmetrically produced, distance across apices nearly as great as width of genital plates, 19:18; Hawaii, Maui, Kauai............**kaonohi** Kirkaldy.

Body form shorter and broader, never more than twice as long as broad; pronotum broader, humeri extending one-twelfth to one-eighteenth of total width of pronotum beyond bases of hemelytra; harpagonal arms never so strongly produced 9

9(8). Color in great part ferrugineous; humeri moderately, angulately produced, extending about one-eleventh or one-twelfth of total width of pronotum beyond bases of hemelytra; second antennal segment longer than fifth.....10

Color light or dark brown; humeri shorter, extending only one-fourteenth or one-sixteenth of total width of pronotum beyond bases of hemelytra.......................11

10(9). Antero-lateral margins of pronotum strongly sinuate; scutellum with middle and apex ivory-white and with fuscous punctures; Oahu ....**sinuata** Usinger.

Antero-lateral margins of pronotum not strongly sinuate; scutellum without distinct white areas; Hawaii....... ....**ferruginea** Usinger.

11(9). Coloration pale brown, ground color testaceous with pale-brown punctures; abdominal spine short, only reaching middle of mesosternum, tapering to briefly rounded apex; humeri very briefly but angularly produced; genital plates small, about one-fourth as wide as capsule; harpagonal arms distinctly produced, five-sixths as wide across apices as width of genital plates; Oahu, Molokai, Maui ....**swezeyi** Usinger.

Color usually darker; abdominal spine long and slender, nearly reaching front coxae, bent downward at tip......12

12(11). Upper surface nearly concolorous, generally fusco-ferrugineous with pale areas, including apex of scutellum, only faintly indicated; humeri very short, extending about one-sixteenth of total width of pronotum beyond bases of hemelytra; genital plates small, one-fourth as wide as capsule; harpagones five-sixths as wide across apices of arms as width of genital plates; Maui........ .... **suehiroae** Usinger.

Upper surface brownish to nearly black with sharply contrasting white markings, particularly on apex of scutellum; humeri usually, but not always, a little more produced, extending one-fourteenth of total width of pronotum beyond bases of hemelytra.....................13

13(12). Genital plates less than one-third as wide as capsule, 14:50; harpagonal arms scarcely produced, apices of harpagones triangular in shape, less than half the width of genital

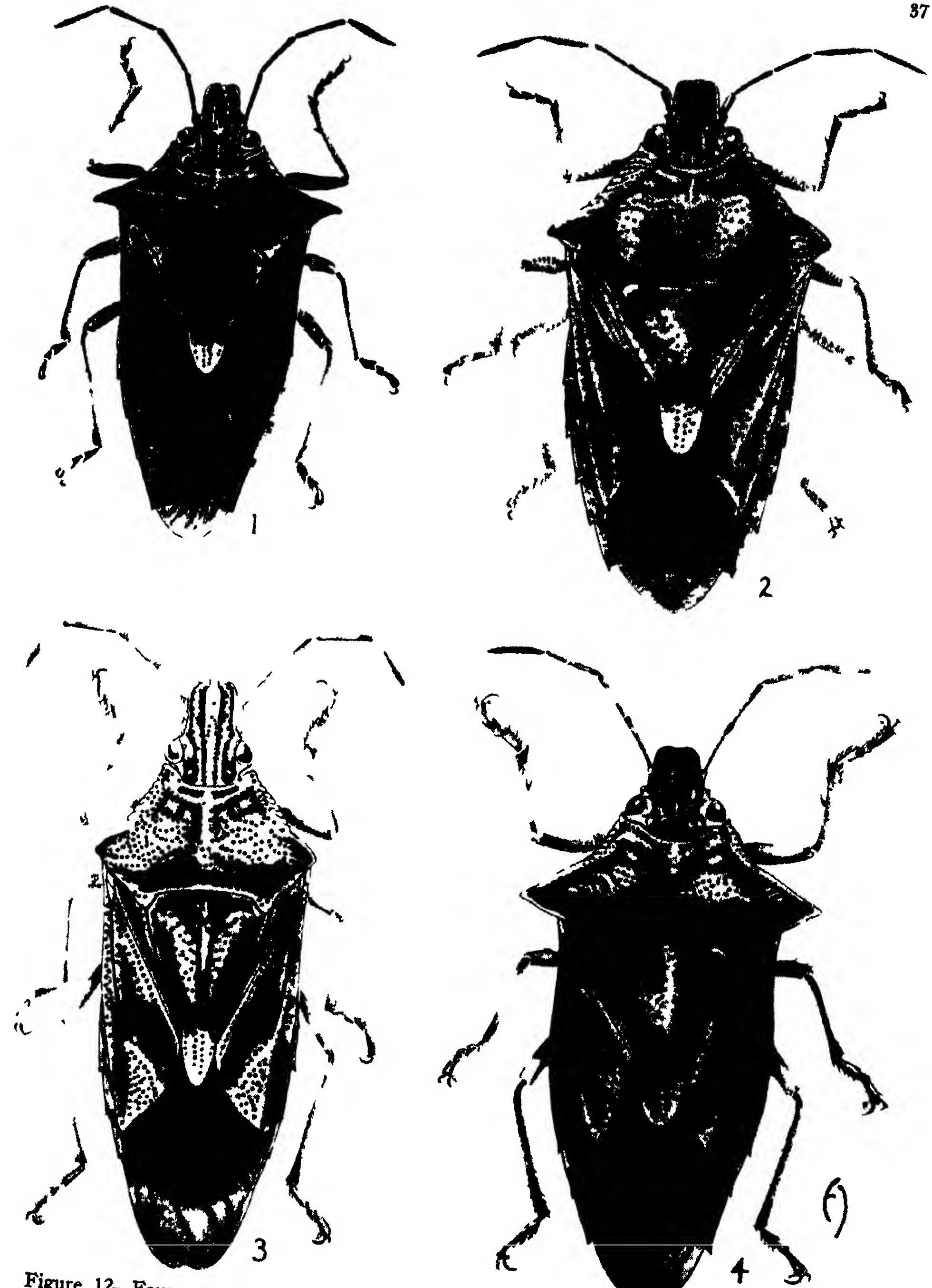


Figure 12—Four species of *Oechalia*: 1, *Oechalia virescens* Usinger, 2, *Oechalia pacifica* (Stål), 3, *Oechalia kaonohi* Kirkaldy; 4, *Oechalia grisea* (Burmeister). (Abernathy drawings.)

plate, 6:15; known only from Kula Pipe Line, 4,500 feet, Maui .... **similis** Usinger.

Genital plates larger, two-fifths as wide as capsule, 19:47; harpagones strongly asymmetrical, ental arms produced upward almost as continuations of inner edges while ectal arms are bent abruptly outward; width measured obliquely across apices of arms about three-fifths width of genital plates, 12:19; Kauai, Oahu, Molokai, Lanai, Maui .... **pacifica** (Stål).

Each of the following species is fully described or redescribed in Usinger's monograph. Some of Van Duzee's species were described from series of specimens which included more than one species and some of his descriptions, therefore, are unreliable.

Oechalia acuta Usinger (fig. 13).
Oechalia acuta Usinger, 1941:82.

Endemic. Hawaii (type locality: Kilauea).
"A large dark colored species with straight, acute humeral spines as in *hirtipes* but with less hairy legs, slightly different male genitalia, and with ferrugineous color." (Usinger, 1941:82.)

Oechalia bryani Usinger (fig. 13).
Oechalia bryani Usinger, 1941:81.

Endemic. Hawaii (type locality: Hookomo, Mauna Kea, 8,500 feet).
Hostplant: *Sophora.*
"Closely allied to ... *hirtipes* and *virgula*. ... However the former is ferrugineous in color and has numerous long erect hairs on the legs and the latter has the harpagones strongly narrowed apically. ... This species is smaller than the other species from Hawaii with the abdominal prolongation longer, the legs less hairy, and the humeri bent slightly but distinctly backwards." (Usinger, 1941: 81, 82.) This is an ochraceous species with dark-brown to black punctures.

Oechalia ferruginea Usinger (fig. 13).
Oechalia ferruginea Usinger, 1941:85.

Endemic. Hawaii (type locality: Kilauea, 4,000 feet).
"This is the only member of the group of species with subrounded humeri known to occur on Hawaii. The humeri are more strongly produced than in other members of the group and the color is ferrugineous." (Usinger, 1941:85.) This species shares with *sinuata* the distinction of being one of the two species which have the second antennal segment longest and the fifth segment shortest.

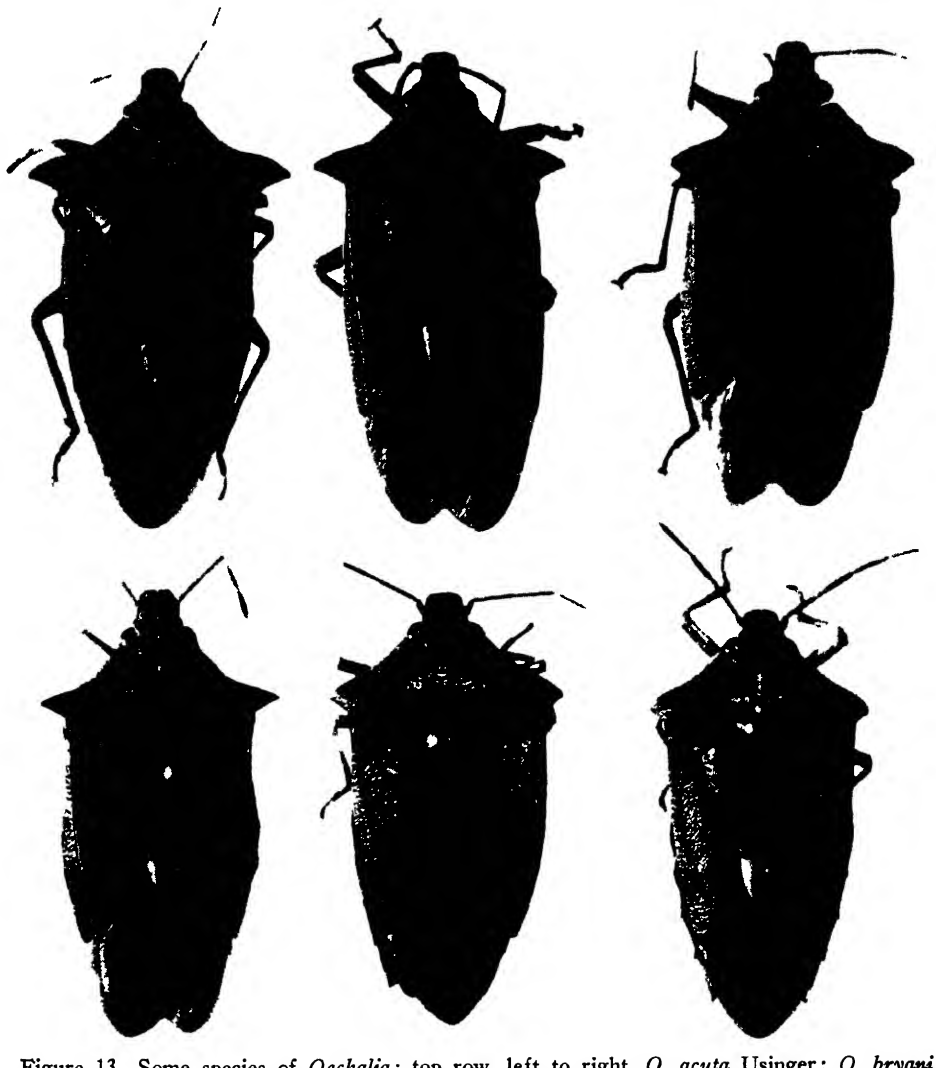


Figure 13—Some species of *Oechalia*: top row, left to right, *O. acuta* Usinger; *O. bryani* Usinger; *O. ferruginea* Usinger, paratype. Bottom row, left to right, *O. hirtipes* Van Duzee, allotype; *O. suehiroae* Usinger; *O. similis* Usinger, allotype.

Oechalia grisea (Burmeister) (fig. 12).

Asopus griseus Burmeister, 1834:293; 1835:360.

Oechalia grisea (Burmeister) Stål, 1862:93; 1870:59. Usinger, 1941:76, redescription.

Endemic. Kauai, Oahu (type locality).

The confusion that existed in the classification of the genus before Usinger's monograph resulted in this specific name being used as a "dumping ground" for

various and sundry records of different species of the genus. Swezey (1942:199) has made some corrections in the early literature.

This is a pale-brown appearing species which is basically ochraceous with black or fuscous punctures.

Oechalia hirtipes Van Duzee (fig. 13).

Oechalia hirtipes Van Duzee, 1936:221. Usinger, 1941:85, redescription.

Endemic. Hawaii (type locality: Kilauea).

"A species with strongly produced, acute humeri and a general ferrugineous color over most of the body." (Usinger, 1941:85.)

Oechalia kaonohi Kirkaldy (fig. 12).

Oechalia kaonohi Kirkaldy, 1909:83, text fig. *b*, male genitalia, pl. 2, fig. 1. Usinger, 1941:91, redescription.

Endemic. Kauai(?), Maui, Hawaii (type locality: Naalehu).

This species "is one of the most distinctive species in the genus, the long slender form and very broad harpagonal arms being unique among the species of *Oechalia* known to me. This is the species which Swezey (1905) studied and illustrated under the name *grisea*. Kirkaldy later described it as a new species but the original name, *grisea*, has since been used by Williams (1931) and Swezey (1936) who reprinted the original plate of illustrations. I can find no specimens of this species collected during the past twenty-five years." (Usinger, 1941:92.) It is peculiar that this species should have been abundant and invaded certain upland sugarcane fields in numbers to attack the sugarcane leafhopper when that insect was at its height and yet not be represented in the collections assembled in the last quarter of a century. It also feeds on *Omiodes accepta*. The isolated Kauai record should be checked carefully.

Oechalia pacifica (Stål) (figs. 11, 12).

Arma pacifica Stål, 1859:221.

Oechalia pacifica (Stål) Stål, 1870:59.

Kirkaldy, 1909:83, pl. 2, fig. 2 (under *grisea*). Usinger, 1941:86, redescription, fig. 1, male terminalia.

Endemic. Kauai, Oahu (type locality), Molokai, Lanai, Maui.

This blunt-shouldered species is highly variable as well as widespread. It is unusual that it has not been found on the island of Hawaii. Occasionally it is found in the lowlands. It has been seen feeding on larvae of the immigrant leaf beetle *Lema trilineata californica* Schaeffer.

Oechalia patruelis (Stål) (fig. 14).

Arma patruelis Stål, 1859:220.

Oechalia patruelis (Stål) Stål, 1870:59. Usinger, 1941:62–66, pl. 1, bionomics; 80, redescription.

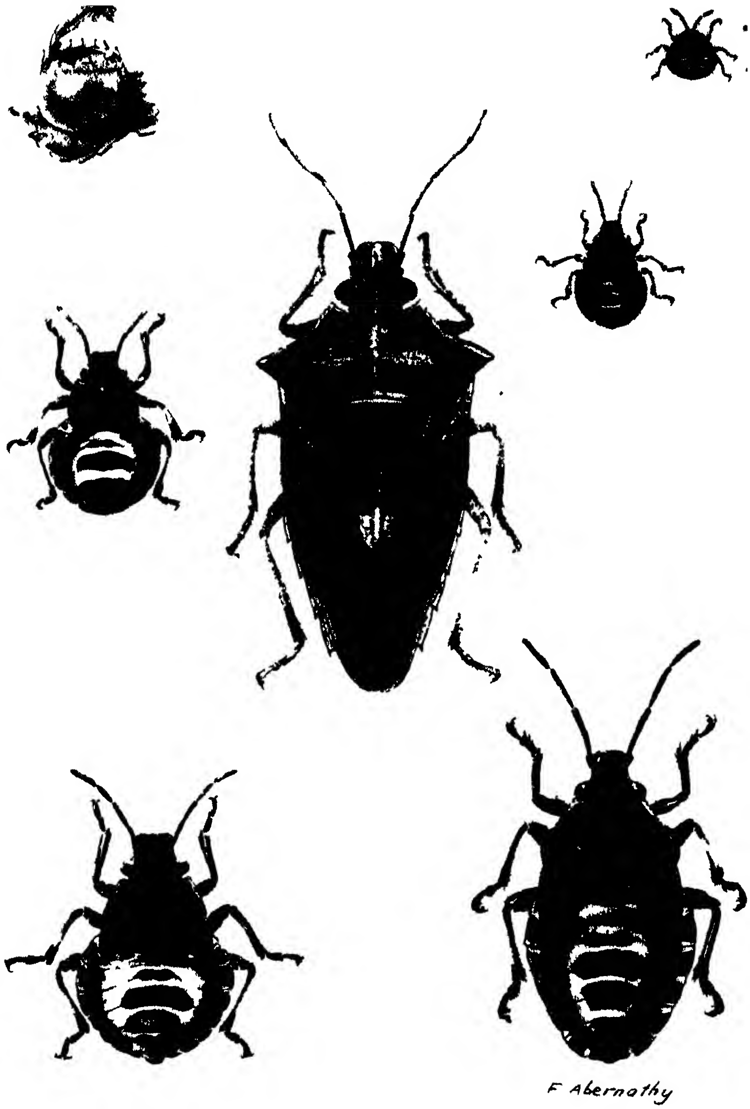


Figure 14—*Oechalia patruelis* (Stål): hatched egg, five nymphal stages and adult. (After Usinger, 1941.)

Endemic. Oahu (type locality: Honolulu).

"Allied to *grisea* and occurring together with that species on the island of Oahu. As in *grisea* the humeral angles are strongly produced and acute but the legs are usually red in color and the harpagones are much less expanded at their tips, being only half as wide as the large genital plates." (Usinger, 1941:80.)

Usinger studied the life history of this species in detail and raised three generations starting with the eggs of one female. The following summary is from his account. A clutch of 14 subrotund eggs were cemented to the under side of a *Coprosma* leaf. The newly laid eggs, which are about 1 mm. thick, are pale cream in color but soon darken to olive-green or fuscous and bear from seven to eleven conspicuous, capitate, threadlike processes around the upper edge near the margin of the operculum. The eggs hatch in eight days. The operculum retains on its inner side the "egg burster" so typical of the Pentatomidae (see the illustration). The first instar nymphs are gregarious; they molt in seven or eight days. The other instars were found to have the following average durations: second, four days; third, three days; fourth, eight days; fifth, eight days. Copulation occurred eight days after the final nymphal molt and eggs were laid six days thereafter. Thus the life cycle from egg to egg may be about two months. For detailed descriptions of the nymphal stages, see Usinger's monograph.

Oechalia similis Usinger (fig. 13).
Oechalia similis Usinger, 1941:88.

Endemic. Maui (type locality: Kula Pipe Line, 4,500 feet).

"Very similar to *pacifica* but with the male harpagones slender, beveled to a sharp edge at apices as in *virgula* from Hawaii." (Usinger, 1941:88.)

Oechalia sinuata Usinger.
Oechalia sinuata Usinger, 1942:217.

Endemic. Oahu (type locality: Mount Kaala).

Hostplant: *Metrosideros*.

"Allied to *ferruginea* Usinger from the island of Hawaii but with strongly sinuate antero-lateral margins of pronotum, sharply contrasting pale and dark areas on the scutellum, and a short, broad body form." It "differs from all other described Oechalias in the type of maculation and in degree of sinuation of antero-lateral pronotal margins." (Usinger, 1942:217–218.)

I have not seen this species.

Oechalia suehiroae Usinger (fig. 13).
Oechalia suehiroae Usinger, 1941:89.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

"Allied to *pacifica* with similar rounded apices of humeri but brownish ferrugineous in color and with the male genital plates scarcely wider than the strongly dilated apices of harpagones." (Usinger, 1941:89.)

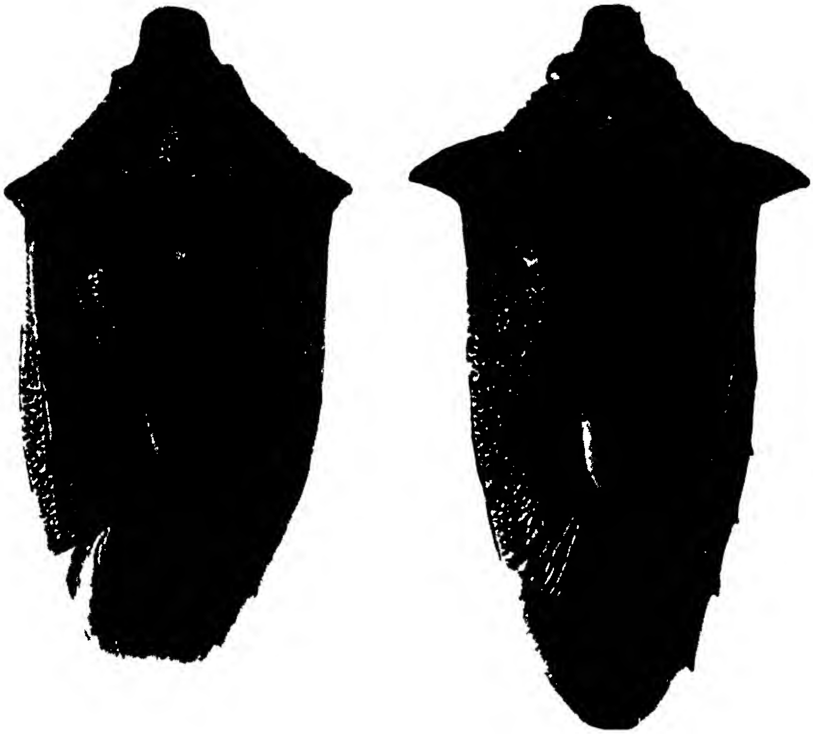


Figure 15—*Oechalia swezeyi* Usinger, allotype, left. *Oechalia virgula* Van Duzee, paratype, right.

Oechalia swezeyi Usinger (fig. 15).
Oechalia swezcyi Usinger, 1941 :90.

Endemic. Oahu, Molokai (type locality: Kanoa), Maui.

This species is "rather uniformly pale, whitish testaceous with brown punctures." It "may be separated from all others by its briefly produced, rounded humeri, pale coloration, and small genital plates with relatively strongly dilated harpagones." (Usinger, 1941 :91.)

Oechalia virescens Usinger (fig. 12).
Oechalia virescens Usinger, 1941 :77.

Endemic. Kauai (type locality: Kokee).

Hostplants: *Scaevola, Straussia.*

"Allied to *grisea* and *patruelis* with humeri as strongly produced and sharp as in those species. Male genitalia small, the harpagones nearly as wide as the genital plates, as in *grisea.* Upper surface entirely or in great part suffused with green." (Usinger, 1941 :77.)

Oechalia virgula Van Duzee (fig. 15).

Oechalia virgula Van Duzee, 1936:220. Usinger, 1941:83, redescription.

Endemic. Hawaii (type locality: Puuwaawaa, 3,700 feet).

Hostplants: *Dodonaea, Myoporum.*

"Very similar in general appearance to *grisea* and *patruelis* with similar sharp humeri but with fulvous or paler legs bearing longer and more numerous erect femoral hairs and with the harpagones very slender, actually narrowed or compressed at the tip rather than expanded as in all other known Oechalias except *similis.*" (Usinger, 1941:83.)

Family **COREIDAE** (Leach, 1815) Samouelle, 1819

The Squash Bugs

The Coreidae have a lygaeid-like facies, the antennae are four-segmented, the rostrum has four segments and the tarsi are three-segmented; two ocelli are present, and the wing membrane has numerous, anastamosing veins.

This is a large, herbivorous family which contains elsewhere numerous economically important species, but, fortunately, we have none of the serious pest species in Hawaii. Only two genera are found here—one is endemic and the other is represented by a widespread immigrant species.

NOTE: While this volume was in proof, details of the discovery of a new immigrant coreid have been announced. This new addition to the fauna, *Coriscus pilosulus* (Herrich-Schaeffer), is discussed and illustrated on page 237.

Key to the Genera of Coreidae Found in Hawaii

1. Hind femora without spines beneath; head much broader across eyes than its length...................**Liorhyssus** Stål.
2. Hind femora armed on lower side with conspicuous spines; head as long as or longer than broad.........**Ithamar** Kirkaldy.

Subfamily RHOPALINAE (Amyot and Serville, 1843) China, 1943

Genus **LIORHYSSUS** Stål, 1870

This widespread genus contains many species.

Liorhyssus hyalinus (Fabricius) (fig. 16).

Lygaeus hyalinus Fabricius, 1794:168. Genotype, fixed by Reuter.

See Van Duzee, 1917:120–121, for synonymy. The generic names *Corizus* and *Rhopalus* have also been used for this species in Hawaiian literature.

Kirkaldy, 1907:146, bionomics.

The hyaline grass bug.

Kauai, 'Oahu, Molokai, Lanai, Maui, Hawaii.

Immigrant. Almost cosmopolitan. First recorded from the Hawaiian Islands by Kirkaldy (1902:170) from specimens collected on Oahu and Hawaii. Probably an early immigrant to the islands, although Blackburn did not collect it.

Hostplants: *Euphorbia cordata, Gossypium tomentosum* (native cotton), *Malva, Reichardia picroides, Sida cordifolia, Sonchus oleraceus.* Feeds upon stems and unopened flower buds.

Parasites: *Microphanurus paractias* (Perkins) and *Microphanurus rhopali* (Perkins) (Hymenoptera: Scelionidae) in the eggs; *Paradionaea* (*Leucostoma*) *atra.* (Townsend) (Diptera: Tachinidae) on the adults.

Predator: *Zelus renardii* Kolenati (Hemiptera: Reduviidae).

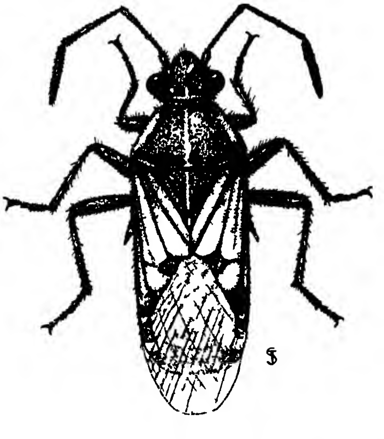


Figure 16—*Liorhyssus hyalinus* (Fabricius). (After Williams, 1931.)

The red, reniform, millimeter-long eggs are laid in clusters, usually on the leaves or in the flowers of the hostplant. I have seen 14 eggs deposited as a mass in a flower head of *Sonchus oleraceus,* the insect's favorite food plant. Kirkaldy (1907: 146–148) noted that an end-to-end position was assumed in copulation, that the usual clutch of eggs is 20 to 25, that the females lay more than one batch of eggs and re-copulate after oviposition. The incubation period is six to seven days, with the five nymphal instars taking only about two weeks. The nymphs gradually change color from largely red in the first instar to largely "yellowish-green testaceous" in the fifth. Kirkaldy (1907:146–148) describes the nymphal instars.

Van Zwaluwenburg (*Proc. Hawaiian Ent. Soc.* 12[1]:23, 1944) found that egg incubation averaged a little more than five days (125 hours) at an average mean temperature of 78.2° F. Fifteen to 16 days were required for the course of five instars. Oviposition occurred between 72 and 78 hours after the insects attained adulthood, and a complete generation, from adult to adult, took 23 or 24 days. A bred female laid 387 eggs on 32 consecutive days (average 12 per day), and lived 35 days.

Subfamily ALYDINAE Stål

Genus **ITHAMAR** Kirkaldy, 1902:169

This is an endemic genus whose genotype is *hawaiiensis*. Van Duzee (1936:222) stated that "It is closely related to *Harmostes* Burm. but may be distinguished by the depressed clypeus, the shorter bucculae and the less expanded pronotal margins which are unarmed before." *Harmostes* is an American genus. Not being

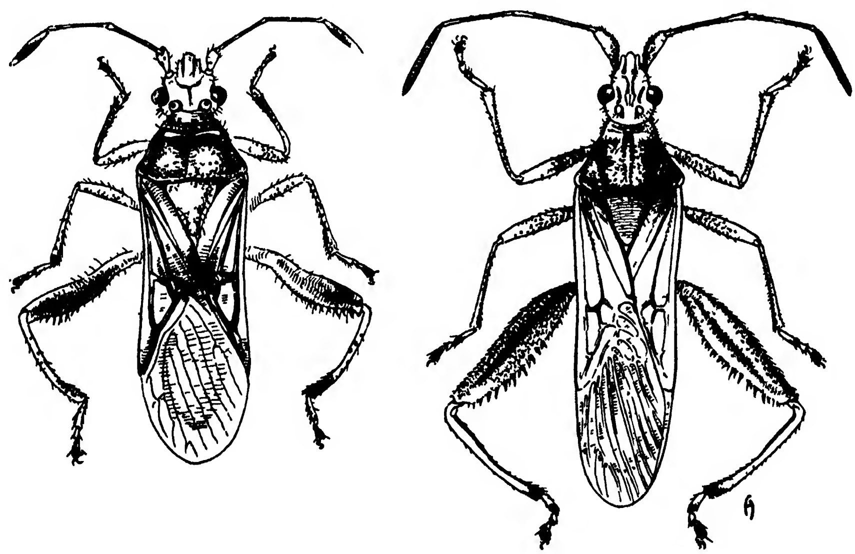


Figure 17—*Ithamar annectans* Van Duzee, left. *Ithamar hawaiiensis* Kirkaldy, right. (Drawn to same scale by Abernathy.)

satisfied with Van Duzee's conclusions, I requested an opinion from Mr. China, and he replied: "*Ithamar* is certainly not closely allied to *Harmostes* Burm. which is a Corizinid whereas *Ithamar* is an Alyinid, two very distinct subfamilies of Coreidae. *Ithamar* appears to be most closely related to the genus *Daclera* Signoret 1863, which has a curious distribution, Reunion Is. (S. Indian Ocean near Madagascar), S. India and Australia. Of course *Ithamar* is very distinct from *Daclera* but the two genera may possibly have had a common origin and are primitive members of the subfamily."

Key to the Species of Ithamar

1. Ocelli situated distinctly behind a line connecting posterior edges of eyes; juga produced and more or less tuberculiform distad and on a level distinctly higher than tylus which is submerged between them distad.......... **hawaiiensis** Kirkaldy.
2. Ocelli situated on a line connecting posterior edges of eyes; tylus on a level higher than juga which are not produced.. .... **annectans** Van Duzee.

Ithamar annectans Van Duzee (fig. 17).

Ithamar annectans Van Duzee, 1936:222.

Endemic. Oahu, Maui (type locality: Iao Valley), Hawaii.

Hostplant: *Euphorbia.*

Ithamar hawaiiensis Kirkaldy (fig. 17).

Ithamar hawaiiensis Kirkaldy, 1902:170, pl. 5, fig. 46.

Endemic. Oahu, Molokai (type locality), Lanai, Maui, Hawaii.

Hostplants: *Euphorbia, Gossypium tomentosum, Sida cordifolia* ("ilima"), *Sophora, Styphelia* (*Cyathodes*).

The eggs, which are deposited in batches of five or more on the under surfaces of the leaves, and the first nymphal instar have been described by Kirkaldy (1907: 148–149).

It abounds on the coasts of some of these [islands], especially frequenting species of *Sida,* is common on the lower edge of the forests in open shrubby places, at 1500 to 3000 ft. above the sea, and again in open places in still higher forest, and far above this to a height of 9000 ft. At higher elevations it breeds on *Cyathodes.* Apparently it exhibits no noteworthy variation in any of these stations. Nymphs in all stages, eggs, and adults are found together on the plants named. The adults frequently wander elsewhere in their flight, and I have taken them in my garden in Honolulu. The hairy nymphs undergo conspicuous changes in the course of their development. This is probably the species that Blackburn supposed might be *Dysdercus peruvianus.* (Perkins, 1913:cxciii.)

This species is now rarely collected.

Family LYGAEIDAE (Shilling, 1829) Herrich-Schaeffer, 1835

Myodochidae, in Fauna Hawaiiensis.

The Chinch Bugs

This family is one of the largest of the Heteroptera. In Hawaii it shares with the Miridae the distinction of being one of the two most developed bug families in the islands. Many members of the group are crop pests in various parts of the world—some of them are of major importance. They are small or medium-sized bugs with the antennae and rostrum four-segmented, two ocelli are usually present, but are absent in some species (*Tempyra,* for example); the tarsi are three-segmented, and the claws have arolia; the veins of the wing membrane are reduced, there being not more than five, usually simple, veins. The species have well-developed scent glands and may emit an obnoxious odor.

Key to the Subfamilies of Lygaeidae Found in Hawaii

1. Hind margin of third ventrite not continued directly to dorso-lateral margins, but peculiarly curved anteriorly before sides .... **Rhyparachrominae.**
   Hind margin of third ventrite normal, entire and similar to that of second 2

2(1). Eyes very large and extending postero-laterally around anterior corners of pronotum; abdominal spiracles on segments four, five and six lateral and visible from side..... .... **Geocorinae.**
   Eyes not so formed; abdominal spiracles dorsal and not visible from side (do not mistake the glandular pores or opaque spots for spiracles).......................... 3

3(2). Veins of hemelytral membrane distinct, second interior vein forked; clavus and corium smooth or roughened but not extensively set with distinct, separated, well-defined punctures .... **Lygaeinae.**
   Veins of hemelytral membrane obsolete or, if present, second interior vein not forked; clavus and corium with distinct, conspicuous punctures .... **Cyminae.**

Subfamily LYGAEINAE (Stål, 1862)

Three tribes of Lygaeinae occur in Hawaii, two of them represented by endemic species. The Metrargini are confined to Hawaii, and I feel that it is to be questioned whether the group should be given a rank equivalent to that of the other two tribes. Rather, I believe that its relationship would be more clearly indicated if the Metrargini were considered a subtribe of the Orsillini, for they appear to be an offshoot of that group.

Key to the Tribes of Lygaeinae Found in Hawaii

1. Antenniferous tubercles, as seen from above, usually strongly produced forward as cone-like, spiniform processes on the antero-lateral corners; coxal flanges strongly punctate..... ....**Metrargini.**

   Antenniferous tubercles not so produced; coxal flanges not strongly punctured 2

2. Our species red and black; hind margin of corium straight and not sinuous ....**Lygaeini.**

   Not red and black species; hind margin of corium slightly sinuous, or at least not entirely straight along its posterior edge ....**Orsillini.**

Tribe LYGAEINI (Stål, 1872)

A single recently immigrant species represents this tribe in the Hawaiian Islands.

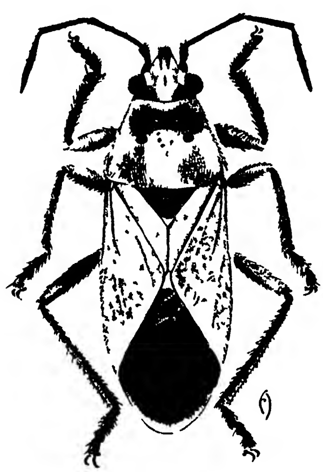


Figure 18—*Graptostethus manillensis* (Stål). (Abernathy drawing)

Genus **GRAPTOSTETHUS** Stål, 1868

Graptostethus manillensis (Stål) (figs. 18, 19, 20).
Lygaeus manillensis Stål, 1859:240.
See China, 1930:115–116, and Usinger, 1947:107, for discussion.

Kauai, Oahu, Maui.

Immigrant. Known elsewhere only from the Philippines, with a closely related species (*nigriceps* Stål) on other Pacific islands, and another relative (*servus* [Fabricius]) on the Asiatic mainland. First found by Sakimura at Kunia, Oahu, in 1942 (Swezey, 1943:284, as *Graptostethus nigriceps*).

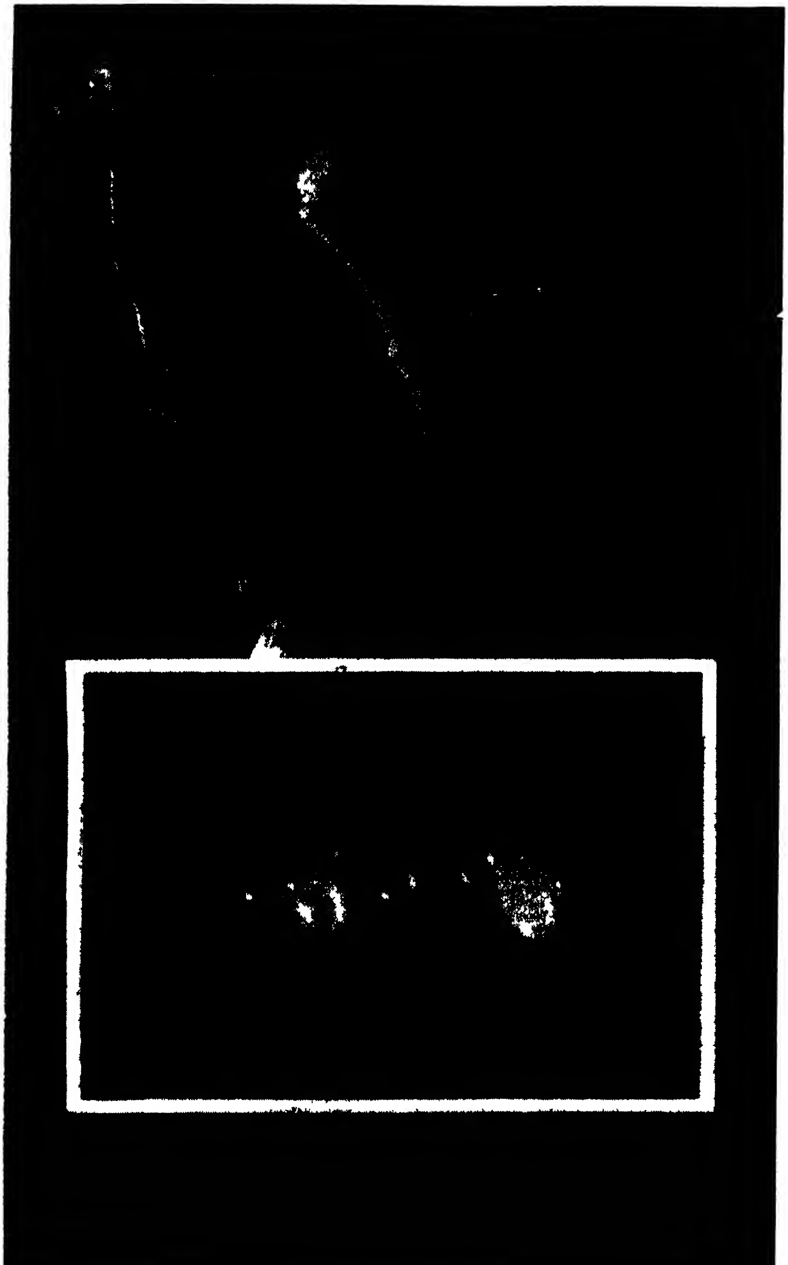


Figure 19—*Graptostethus manillensis* (Stål). Eggs in place at the base of a *Merremia tuberosa* capsule, and the same enlarged in inset. (After Swezey, 1945.)

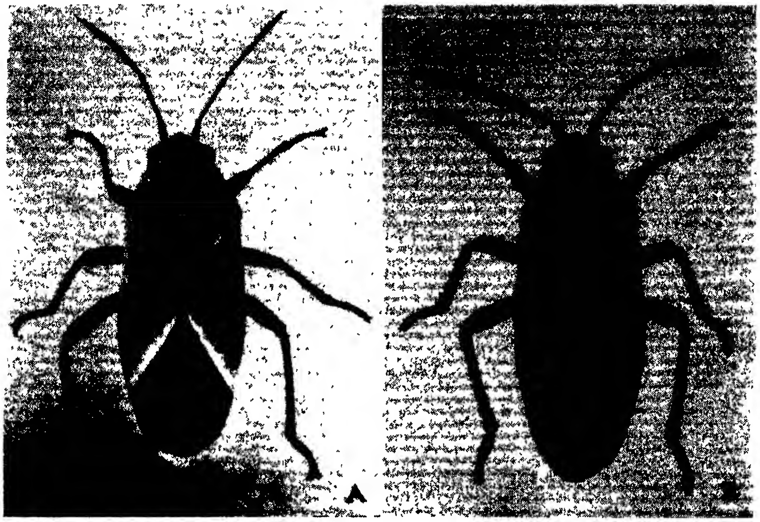


Figure 20—*Graptostethus manillensis* (Stål). Photographs of two color phases: **A**, the form with thorax, clavus and corium red with black markings; **B**, the form with thorax, clavus and corium mostly red. (After Swezey, 1945.)

Hostplants: *Ipomoea horsfalliae* (Kuhio vine), *Merremia* (*Ipomoea*) *tuberosa* (wood rose).

There is no other bug in Hawaii with which this striking species might be confused. Its red and black coloration is distinctive. There are two principal color forms: one has the hemelytra, excepting the membrane, immaculate and the pronotum has only two black dots; the other form has a broad black fascia at the distal third and a large black sub-triangular or arrowhead-shaped macula on each side behind the transverse band.

Swezey (1945:335, under the name *servus*) has summarized the local information regarding the species and gives notes on its biology. I have seen the adults feeding on the ovaries of the Kuhio vine.

Tribe ORSILLINI (Stål) Van Duzee, 1916

Orsillaria Stål, 1872.
Nysiina Uhler, 1876.
For a detailed description of the group including an extended discussion, see Usinger, 1942:14.

This is the largest and apparently the most complexly developed tribe of bugs in Hawaii. It is the only major group of Hawaiian Heteroptera which has received adequate attention and may be assumed to be fairly well known. For our knowledge of the Hawaiian Orsillini, we are indebted to Usinger and his outstanding monograph of the Hawaiian members of the tribe (1942:1–167, figs. 1–9, pls. 1–12). In my opinion, Usinger's report is one of the finest pieces of work ever written

on any group of Hawaiian insects. It is so complete that I can add almost nothing new here. However, the last word has not been written on the Hawaiian complex, and much work awaits completion. I have abstracted freely from Usinger's paper and have used his keys, but I have modified and recast them to fit the style used in this manual, and I have found it necessary to alter some of the sections which appear to me to need strengthening. I believe use will reveal other necessary changes.

About one-half of the described species of the world's Orsillini occur in Hawaii. Some of them are beautiful insects, in spite of their mostly somber colors. The local group is complexly developed and is, therefore, a taxonomically difficult assemblage of forms. The status of some of the genera and certain of the species and lesser forms may be open to question, but these are problems that only more detailed investigations, and perhaps breeding experiments, can solve—if they can be solved by the methods available to us.

The Hawaiian Orsillini include some of the most common and most abundant of all Hawaiian insects. Species occur from near the seashore to the tops of the mountains. Some species are numerous on introduced plants in lowland areas where almost every other vestige of indigenous insect life has been exterminated or driven out.

Perkins (1913:cxcv) said that "The disgusting odour that they emit" renders them "unpleasant objects to collect." Some of us are not so disturbed by their "buggy" odor.

Some of our species, because of their lowland distribution and their breeding on foreign plants, have almost all the characteristics of non-endemic insects. This is another peculiarity of the group.

Because the tribe is much more highly developed and diversified than the early workers considered it to be, many of the records existing in literature prior to Usinger's monograph are erroneous and should be ignored unless checked with great care. For example, Kirkaldy considered at least one of our species to be the same as the Australian crop pest *Nysius vinitor* Bergroth and published notes on its biology under that name. Swezey (1942:200–202) has published a list of corrections to the confused local literature concerning the group.

The foreign *Nysius vinitor* Bergroth (the Rutherglen bug) of Australia and *Nysius ericae* (Schilling) (the false chinch bug) of Europe and North America are notorious crop pests. Certain other species of *Nysius* cause damage to various truck and orchard crops in various parts of the world. Sporadic damage by certain predominantly lowland species of *Nysius* is reported in Hawaii from time to time. The species involved are usually *Nysius nemorivagus* White, *N. coenosulus* Stål, *N. terrestris* Usinger and *N. nigriscutellatus* Usinger. These species often build up unusually high populations on various weeds (such as amaranth and *Portulaca*), and then, because of overcrowding, lack of ample food or the drying up or removal of their hostplants, swarms of the bugs may transfer their interests to certain truck crops or fruits and may on occasion cause some damage. Certain observers, however, are likely to become unduly alarmed over these habits in

Hawaii. Some of the species, I feel, have been accused unjustly of doing damage to various crops simply because they have been seen resting on the plants, or other bugs have been confused with them (see note under *Pachybrachius nigriceps*). It appears that a logical approach to preventive and control measures would here consist of adequate clean culture in the fields to reduce the available weed hosts early in the season and thus discourage the building up of large *Nysius* populations. It is merely asking for trouble to have one's truck gardens surrounded and invaded by masses of known *Nysius* weed hosts. Special attention should be given to clearing amaranth, *Portulaca* (pig weed) and *Erigeron* from the fields if *Nysius* do cause trouble.

I feel that the hostplant lists need careful checking, because the species are frequently captured while resting on a plant upon which they do not feed.

Among the insect parasites and predators of the Hawaiian Orsillini may be mentioned the scelionid wasp *Microphanurus vulcanus* (Perkins) (*Telenomus*), which has been reared from the eggs of a species of *Nysius*; the Nabidae, Reduviidae and Anthocoridae (which groups attack principally the nymphs); and the larrid wasp *Silaon rohweri* Bridwell, which provisions its nests with various orsillines. Spiders, toads, skinks, geckoes, certain birds and the voracious ant *Pheidole megacephala* (Fabricius) all exert pressure upon various Orsillini. Usinger's observations (1942:154) that "toads, skinks, and geckoes, although feeding extensively on invertebrates in the lowlands, have not been observed frequenting the particular places where *Nysius* occur" needs modification.

Usinger was able to make a number of observations on the nymphal stages of several species of various groups and his paper should be consulted for details. The following is his key to the nymphs of 10 species representing three of the five genera. The immature stages of *Nesomartis* and *Glyptonysius* have not been studied.

Key to the Nymphs of Some Hawaiian Orsillini

1. Head with at least two complete, anteriorly divergent, longitudinal, black or white fasciae sublaterally near eyes. Genus *Nysius* 2

Head black or white-marked but with only a short, incomplete spot or stripe on either side along inner margin of epicranial arm near eyes and often with the inner stripes incomplete or wanting 3

2(1). Discs of head and thorax in great part fuscous with white spots; sides of pronotum and hemelytral pads laterally scarcely lamellately expanded, very narrowly pale.... ....**Nysius rubescens** White.

Discs of head and thorax in great part longitudinally alternately striped with fuscous and white, the fuscous areas more or less spotted with white; sides of pronotum and hemelytral pads broadly, lamellately expanded and broadly pale ....**Nysius coenosulus** Stål.

3(1). Epicranial arms scarcely sinuate near inner, posterior angles of eyes; head very long, broad and convex in

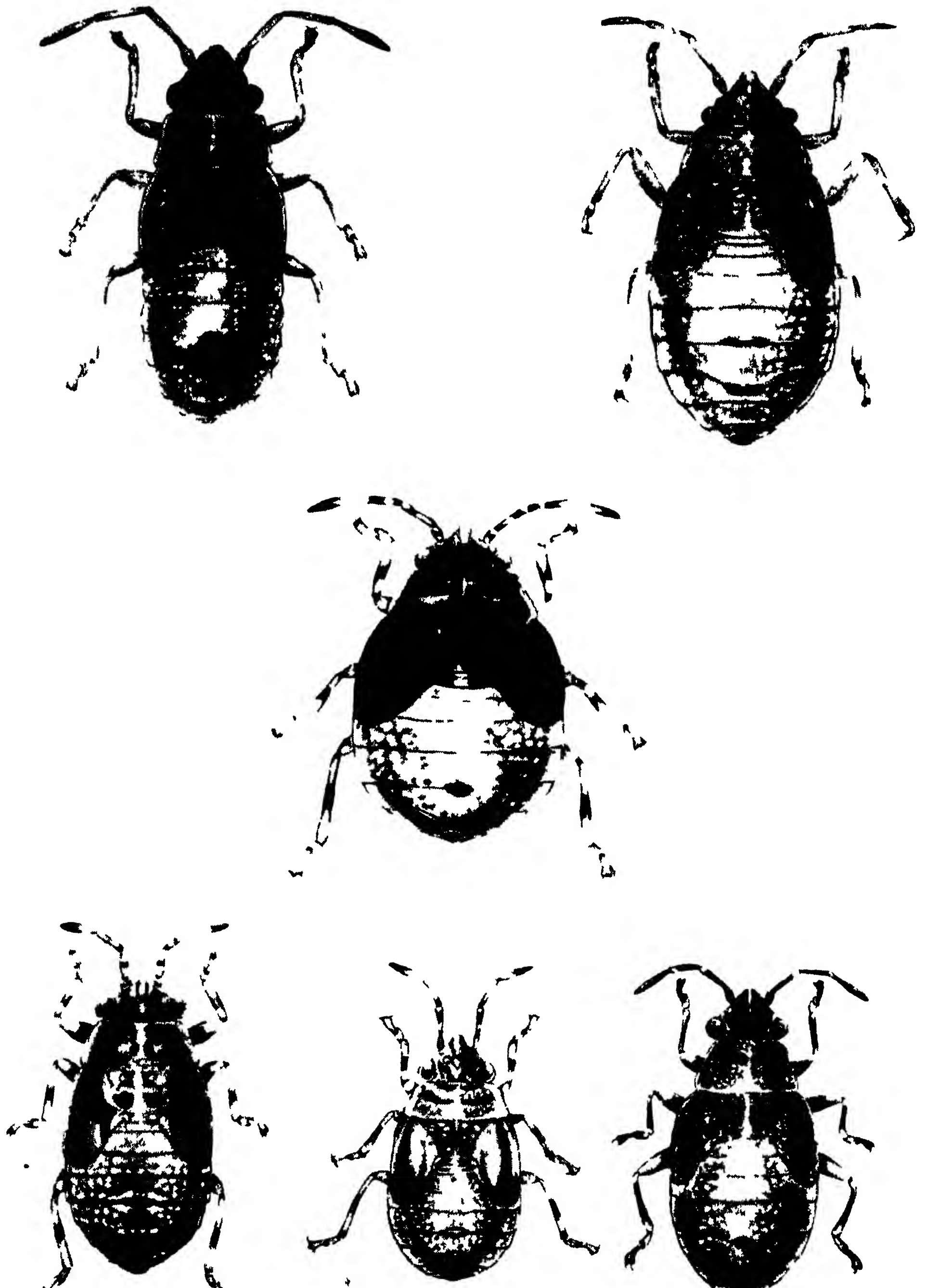


Figure 21—Last nymphal instars of some Orsillini. Top: left, *Oceanides nimbatus* (Kirkaldy); right, *Neseis* (*Icteronysius*) *ochriasis maculiceps* (Usinger). Middle: *Neseis* (*Physonysius*) *molokaiensis* Usinger. Bottom: left, *Neseis* (*Trachynysius*) *fasciatus fasciatus* Usinger; middle, *Neseis* (*Trachynysius*) *fulgidus* Usinger; right, *Nysius rubescens* White. (After Usinger.)

front of eyes; pronotum and hemelytral wing pads roundly convex, abruptly depressed and narrowly lamellate at sides. Genus *Oceanides* 4

Epicranial arms distinctly sinuate near inner posterior angles of eyes; head often subflattened above and always less convex anteriorly; pronotum and hemelytral wing pads much flatter, sides often strongly lamellately expanded. Genus *Neseis* 6

4(3). Head, pronotum and mesonotum, including hemelytral pads, entirely black except for narrow lamellate margins ....**Oceanides nubicola** (Kirkaldy).

Head and thorax above, light brown with darker markings.. 5

5(4). Color pale fulvous with darker brown on base of head, callosities, and hemelytral pads apically; size small, 3.27 mm. in length.........**Oceanides membranaceus** Usinger.

Color darker brown with pale spots on pronotum and mesonotum and dark brown to black callosities and hemelytral pads apically; size larger, 4.72 mm.................. ....**Oceanides nimbatus** (Kirkaldy).

6(3). Head and thorax brown, entirely pale-spotted or streaked; head ivory-white with distinctive longitudinal brown markings; hemelytral pads neither lamellately expanded nor sublaterally impressed........................ .....**Neseis (Icteronysius) ochriasis maculiceps** (Usinger).

Head and thorax otherwise, hemelytral pads clear and immaculate at middle, lateral margins either lamellately expanded or sublaterally impressed.................... 7

7(6). Body very broad, particularly posteriorly, two-thirds as broad as long, hemelytral pads distinctly, sublaterally impressed....**Neseis (Physonysius) molokaiensis** Usinger.

Body more slender, about half as wide as long, hemelytral pads distinctly expanded. *Neseis* subgenus *Trachynysius*.. 8

8(7). Rostrum short, not reaching posterior coxae........... ....**Neseis (Trachynysius) fasciatus** Usinger.

Rostrum longer, exceeding posterior coxae............... 9

9(8). Body short, broad and subflattened above, only twice as long as broad, head only indistinctly marked with brown; size small, 2.77 mm............................. ....**Neseis (Trachynysius) fulgidus** Usinger.

Body longer and more slender, over twice as long as broad, 77:33; color very pale, head with ivory-white markings; size larger, 4.27 mm............................ ....**Neseis (Trachynysius) nitidus pipturi** Usinger.

I have made some changes in Usinger's key to the genera, which, I trust, will enable workers to use it with more facility than was previously possible. Some of the characters, as originally outlined, are rather obscure and misleading to one unfamiliar with the complexes of species involved. Moreover, certain of the characters originally used appear to me to be specifically variable and are apt to be variously interpreted by different readers. Such changes are to be expected in

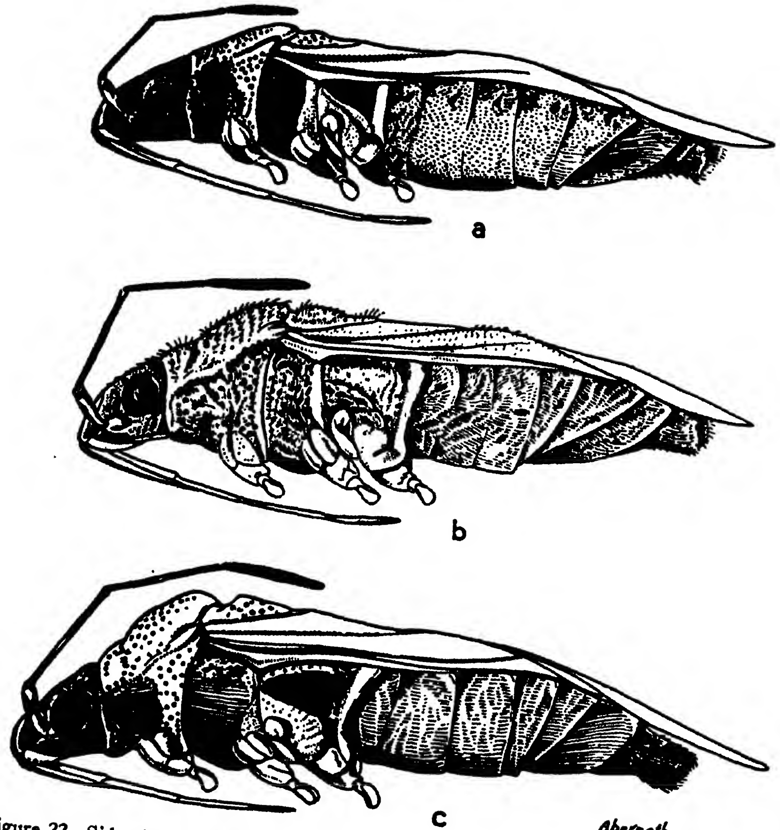


Figure 22—Side views of females of three genera of Orsillini to show some of the characters used in the following keys. a, *Oceanides nimbatus* (Kirkaldy); b, *Nysius delectus* White; c, *Neseis (Trachynysius) saundersianus* (Kirkaldy). (After Usinger, 1942.)

any complex work. Additional alterations and corrections will have to be made, for it is only by use that the keys can be perfected. Before using the generic and specific keys, the reader should thoroughly familiarize himself with the nature of the characters involved and make full use of all the illustrations. Most of these insects have good differential characters, but they must be examined with care if one is to identify his collections properly.

Key to the Genera of Hawaiian Orsillini

1. Body in great part clothed with subappressed, pale pubescence, distinct on clavus and corium and often with longer, erect hairs as well (fig. 22, b); claval sutures and vein R+M usually without conspicuous rows of punctures except sometimes basad (these punctures distinct in *Nysius sublittoralis* and less distinct in *Nysius*

fucatus) ; posterior margin of metapleuron concave, its outer angle moderately produced and rounded (fig. 22, b) ; elevated parts of bucculae reaching about midway between level of apices of antenniferous tubercles and base of head (fig. 22, b) 2

Body almost naked above (fig. 22, a, c), or at least without a subappressed pubescence on clavus and corium (except in *Oceanides pteridicola,* in which the postero-lateral angle of metapleuron is a right angle) ; claval sutures and vein R+M with distinct rows of punctures. Postero-lateral angle of metapleuron usually either sharply right-angled (fig. 22, a) or subangulately produced (fig. 22,c) ; elevated parts of bucculae scarcely surpassing level of antenniferous tubercles (fig. 22, a, c) 3

2(1). Head, including eyes, broader than greatest width of pronotum .... **Nesomartis** Kirkaldy.

Head, including eyes, always narrower than greatest width of pronotum .... **Nysius** Dallas.

3(1). Upper surface of head relatively strongly elevated along middle, as viewed from side, with conspicuous, sinuous wrinkles; posterior margin of metapleuron rectilinear, its posterior angle a right angle..... **Oceanides** (Kirkaldy).

Head variously formed but never with above combination; posterior margin of metapleuron always more or less concave, postero-lateral angle either moderately produced and subrounded or strongly produced and subacute...... 4

4(3). Antenniferous tubercles angular laterally and sub-carinate, the "carinae" extending back to inner anterior margins of eyes (best seen from above), the distance between fore edge of eye and apex of tubercle about three-fourths or more than three-fourths as long as first antennal segment; pronotal and hemelytral discs with brown to black, laevigate elevations as in figures of *Glyptonysius* (fig. 27), but do not confuse with the usual smooth anterior callosities on *Neseis*......... **Glyptonysius** Usinger.

Antenniferous tubercles not laterally carinate, much shorter, usually less than one-half as long as antennal segment one; pronotal and hemelytral discs without irregular laevigate elevations, except for usual pronotal callosities .... **Neseis** (Kirkaldy).

Genus **OCEANIDES** (Kirkaldy, 1910:536) Evans, 1929:353

This endemic genus was redescribed by Usinger (1942:17–18). It shares with *Neseis* and *Glyptonysius* the mostly naked dorsum (excepting *Oceanides pteridicola*), but most of the species have the head more convex (so that when viewed from the side the median line rises distinctly above the level of the tops of the eyes), distinctly more coarsely sculptured, and the hind margin of the metapleuron is nearly straight, not distinctly concave, and its postero-lateral angle is a right angle or nearly so.

Although Usinger recognized 23 forms in this genus, he considered them all full species and named no subspecies nor varieties. Thus, this genus contains more *full species* than any of the other groups, although the *Neseis* complex has 20 species with 14 subspecific and varietal forms. *Nysius,* itself, has 22 species and two lesser forms.

Two keys to the species are given below. The first of these is recast from Usinger; the other is a set of new tables primarily based upon geographical distribution.

Key Section I

General Key to the Species of Oceanides

1. Clavus and corium clothed with very short, appressed, pale hairs; Maui and Hawaii.............. **pteridicola** (White).
   Clavus and corium naked, or with scattered, almost invisible, short, erect bristles.......................... 2

2(1). Clavus and corium distinctly but irregularly marked with dark brown to ferrugineous spots or blotches, some of which anastomose, the maculations of the two sides usually asymmetrical 3
   Clavus and corium more or less maculated but always regularly and symmetrically............................ 4

3(2). Costal margins of coria evenly arcuate throughout; Oahu, Molokai, Lanai, Maui............ **montivagus** (Kirkaldy).
   Costal margins of coria strongly dilated but subparallel at middle, being widest anteriorly in male and posteriorly in female; Hawaii...................... **vulcan** (White).

4(2). Entire body, or at least parts of pronotum, with distinct reddish or reddish-ferrugineous tinge................. 5
   Body ochraceous or paler with brown or black markings.... 9

5(4). Rostrum not surpassing posterior coxae; membrane rather uniformly embrowned, with veins sometimes faintly paler; Oahu .... **delicatus** Usinger.
   Rostrum slightly to distinctly surpassing posterior coxae, reaching second abdominal segment at least; membrane variously maculated but never evenly embrowned throughout 6

6(5). Rostrum reaching only onto second abdominal segment, first segment not or scarcely reaching base of head; membrane generally infuscated with veins clear, thus forming, when crossed at rest, an oblique cross-hatching of pale lines 7
   Rostrum reaching third abdominal segment at least, first segment slightly surpassing base of head; membrane pale basally and on either side near apices of coria........ 8

7(6). Anteocular portion of head distinctly longer than an eye; pronotum rather sparsely punctate, irregular rows of punctures on posterior lobe more than one puncture width apart; size large, 4.4 to 5 mm.; Hawaii......... .... **nubicola** (Kirkaldy).

Anteocular portion of head subequal to, or a little shorter than, length of an eye; pronotum densely punctate, irregular rows of punctures on posterior lobe less than one puncture width apart; size usually smaller, 3.94 to 4.5 mm.; Kauai .... **myopori** Usinger.

8(6). Membrane very distinctly marked with brown, broadly from middle of apical margins of coria on either side, then more narrowed to center and thence widening, fan-like, to apex; elsewhere clear, white; size small, 4.11 to 4.55 mm.; Oahu.................... **picturatus** Usinger.

Membrane indistinctly pale basally and laterally; size larger, 4.86 to 5.13 mm.; Kauai............... **ventralis** Usinger.

9(4). Rostrum not or scarcely exceeding posterior coxae.........10

Rostrum reaching middle of second abdominal segment or beyond 14

10(9). Pronotum relatively densely punctate, punctures coarse and much less than one puncture width apart except posteriorly; with four or five rows of closely approximated punctures in front of callosities; clavus and corium uniformly brown in color with a darker brown spot at middle of apical margin of corium; membrane uniformly, palely infuscated; large and strongly dilated posteriorly, 5.7 to 6.2 mm. by 2.3 to 2.5 mm.; Maui...... **dilatipennis** Usinger.

Pronotum less densely and usually more finely punctate, with not more than three rows of punctures in front of callosities; hemelytra never as above; size usually much smaller and never exceeding 5.16 by 2.2 mm............11

11(10). Pronotum comparatively long and narrow (fig. 23, *bimaculatus*, and fig. 26, *sinuatus*), more than 60 percent as long as broad, posterior lobe pale, or at most with humeral angles darker; clavus immaculate and corium with black marks narrowly confined to apical margin and only broadening out to costal margin subapically in one species 12

Pronotum shorter and broader, less than 60 percent as long as broad, posterior lobe varying in color but usually with broad, sublateral fuscous areas extending to posterior margin; clavus infuscated at least apically; corium sometimes infuscated basally and always broadly fusco-maculate on apical fourth except laterally and subapically.....13

12(11). Head densely clothed with long, appressed, pale hairs; corium distinctly marked with brown along apical margin and sometimes dark at inner and outer ends of apical margin; pronotal disc with numerous fine punctures; lateral margins scarcely sinuate; Maui...............
.... **bimaculatus** Usinger.

Head only sparsely clothed with a short, appressed, pale pubescence; corium slightly embrowned along entire apical margin, with a small spot at middle of apical margin; pronotal disc with only a few coarse punctures; sides distinctly sinuate; Oahu........... **sinuatus** Usinger.

13(11). Head above very strongly, irregularly rugose; clavus and

corium broadly fusco-maculate both basad and along at least inner half of apical margin; Oahu...**perkinsi** Usinger.

Head less strongly rugose and often smooth or slightly transversely wrinkled at middle; clavus and corium immaculate basad; Oahu...............**arboricola** (White).

14(9). Clavus and corium entirely pale and immaculate or, at most, with a spot or U-shaped mark at apex of cell R+M 15

Clavus often infuscated apically and corium always with more extensive markings along apical margin, including a broad fuscous spot apically between vein Cu and claval suture 16

15(14). Anteocular part of head shorter than an eye; pronotal disc subflattened; size small, 4.22 to 4.66 mm. long; Kauai ....**planicollis** Usinger.

Anteocular part of head longer or occasionally (Lanai specimens) subequal to length of eyes; pronotal disc moderately convex; size larger, 4.66 to 6.11 mm.; all the islands except (?) Molokai.......**nimbatus** (Kirkaldy).

16(14). Color often very dark, the dark-brown to black areas exceeding in extent the pale areas and at least with large black marks at middle of basal third of corium as well as broadly along apical margin; pronotum usually entirely black except for pale humeri and a pale spot at middle of posterior margin..........................17

Black markings of hemelytra always less extensive.........18

17(16). Body form broadly oval; pronotum impunctate and transversely rugose posteriorly; membrane black, even at base; Maui ....**oresitrophus** (Kirkaldy).

Body form elongate-oval, slender; pronotum at least sparsely punctate and transversely rugose posteriorly; membrane pale at base and with pale veins; Oahu..... ....**oribasus** (Kirkaldy).

18(16). Membrane with a dark-brown mark from middle of apical margin of corium on either side, extending apically, crossing at middle, and when hemelytra are folded at rest, appearing narrowly expanded, fanlike, posteriorly; Oahu ....**membranaceus** Usinger.

Membrane variously variegated or infuscated but never as above 19

19(18). Rostrum very long, reaching well onto, or exceeding, third abdominal segment; Oahu ....**incognitus** Usinger.

Rostrum not exceeding second abdominal segment........20

20(19). Posterior lobe of pronotum rather extensively embrowned, at least sublaterally; subapical corial spots practically reaching costal margins; membrane generally infuscated, without conspicuously clear veins; Kauai............ ....**rugosiceps** Usinger.

Posterior lobe of pronotum immaculate or with brown confined to humeri; subapical corial spots not approximating costal margins; membrane variably infuscated but with veins, at least, clear.......................21

21(20). Clavus infuscated apically; upper surface of head and margins of callosities with very inconspicuous, pale, appressed hairs; Hawaii ....**bryani** Usinger.
Clavus immaculate apically; upper surface of head and margins of callosities with a distinct, conspicuous, golden, appressed pubescence 22
22(21). Humeral angles immaculate; callosities black; pronotum relatively long and broad; Lanai.........**fosbergi** Usinger.
Humeral angles brown; callosities pale brown to ferrugineous; pronotum short and narrowed; Oahu........ .... **parvulus** Usinger.

It is worth while, I believe, to present here an additional key, based primarily upon geographical distribution, to facilitate identification of the 23 described forms of *Oceanides.* Only three members of the genus have been found on more than one island. *O. pteridicola* has been collected on Maui and Hawaii, *O. montivagus* on Oahu, Molokai, Lanai and Maui, and *O. nimbatus* has been taken on Kauai, Oahu, Lanai, Maui and Hawaii. Inasmuch as there has been only one species found on Molokai (*montivagus*), that island is not included in the following tabulation. It should be kept in mind that keys based primarily upon geographical segregation will work only so long as the known distribution remains as at present. We may with good reason expect that *O. nimbatus,* which occurs on all of the main islands excepting Molokai, will be found on that island when more extensive collecting is done, and, also, that other species of *Oceanides* inhabit Molokai but have not yet been discovered. The main key should be used to check identifications where necessary.

Key Section II

Island Keys for the Separation of the Species of Oceanides

Section A—Key to the Kauai Oceanides

1. Entire body, or at least parts of pronotum, with a distinct reddish or reddish-ferrugineous tinge.................. 2
Body ochraceous or paler with brown or black markings.... 3
2(1). Rostrum reaching only onto second abdominal sternite, its first segment not or scarcely reaching base of head; wing membrane generally infuscated with veins clear, thus forming, when crossed at rest, an oblique cross-hatching of pale lines.........................**myopori** Usinger.
Rostrum reaching third abdominal sternite at least, its first segment extending slightly behind base of head; membrane pale basad and on either side near apices of coria .... **ventralis** Usinger.
3(1). Rostrum extending only to about middle of ventrite two.. ....**planicollis** Usinger.
Rostrum extending onto third ventrite.................. 4
4(3). Corium with a brown mark at apex of cell R+M, wing otherwise almost immaculate, pale....**nimbatus** (Kirkaldy).
Corium with at least two large maculations, one near apex of claval suture and one which may extend from cell R+M nearly to wing margin.........**rugosiceps** Usinger.

SECTION B—KEY TO THE OAHU OCEANIDES

1. Clavus and corium irregularly marked with numerous dark spots and blotches, some of which anastomose........ ....**montivagus** (Kirkaldy).
Clavus and corium with comparatively regular and symmetrical maculations 2
2(1). Rostrum not or hardly reaching behind metacoxae......... 3
Rostrum extending to or beyond middle of second abdominal segment 6
3(2). Pronotum more than 60 percent as long as broad........... 4
Pronotum less than 60 percent as long as broad............ 5
4(3). Pronotal callosities reddish-brown; lateral arcuation of corium beginning distinctly behind base...**delicatus** Usinger.
Pronotal callosities shiny black; lateral arcuation evidently continuous from base ....**sinuatus** Usinger.
5(3). Clavus and corium with a large, conspicuous, common, dark humeral blotch; rostrum not extending behind metacoxae, first segment reaching base of head......**perkinsi** Usinger.
Clavus and corium without such humeral maculation; rostrum extending behind metacoxae, its first segment distinctly not reaching base of head.......**arboricola** (White).
6(2). Clavus and corium almost entirely pale, with only a U-shaped mark at apex of cell R+M....**nimbatus** (Kirkaldy).
Clavus and corium largely dark or with more extensive maculations... 7
7(6). Very dark species, almost entirely dark brown or black, dark areas usually much more extensive than pale maculations ....**oribasus** (Kirkaldy).
Much paler species, pale areas more extensive than dark maculations 8
8(7). Membrane (hemelytra closed at rest) with an oblique vitta running from each corium to middle line, thence expanding down middle to apex, this mark often appearing Y-shaped; at least with a distinct median vitta....... 9
Membrane spotted, but never with such a pattern as indicated above 10
9(8). Sides of body with a reddish tinge; clavi dark distad; rostrum reaching third abdominal segment..**picturatus** Usinger.
Sides of body not tinged with red; clavi immaculate; rostrum reaching middle of second ventrite.......... ....**membranaceus** Usinger.
10(8). Rostrum reaching beyond middle of third abdominal segment ....**incognitus** Usinger.
Rostrum reaching middle of second ventrite........... ....**parvulus** Usinger.

SECTION C—KEY TO THE LANAI OCEANIDES

1. Rostrum reaching third abdominal sternite............ ....**nimbatus** (Kirkaldy).
Rostrum not extending behind middle of second ventrite... 2

2. Clavus and corium irregularly and conspicuously maculate throughout .... **montivagus** (Kirkaldy).
Clavus immaculate or nearly so, corium maculate only near membrane .... **fosbergi** Usinger.

SECTION D—KEY TO THE MAUI OCEANIDES

1. Dorsum, except membrane, clothed with conspicuous, appressed, pale hairs.................. **pteridicola** (White).
Dorsum, at least clavus and corium, naked, or with scattered, almost invisible, short, erect setae................ 2

2(1). Rostrum not or hardly passing posterior edges of metacoxae.. 3
Rostrum reaching or passing middle of second abdominal ventrite 4

3(2). Pale-yellowish species; coria with only about two or three dark maculae and these caudad; lateral margins of pronotum hardly sinuous, nearly straight................ .... **bimaculatus** Usinger.
Dark-brown to black species, hemelytra almost entirely dark; lateral margins of pronotum conspicuously, strongly sinuous .... **dilatipennis** Usinger.

4(2). Rostrum extending onto third abdominal ventrite; pale species with hemelytra with only a conspicuous dark spot near apex of vein R............... **nimbatus** (Kirkaldy).
Rostrum not reaching third ventrite; hemelytra with more numerous maculations 5

5(4). Posterior part of pronotum distinctly punctate and without a trace of transverse wrinkles; clavi and coria with numerous, small, irregular, anastomosing maculae forming an almost subreticulate pattern..**montivagus** (Kirkaldy).
Posterior part of pronotum nearly impunctate and with three or four conspicuous, transverse wrinkles; clavi nearly immaculate, coria with several comparatively large and regular maculae (about four on each corium)..... .... **oresitrophus** (Kirkaldy).

SECTION E—KEY TO THE HAWAII OCEANIDES

1. Dorsum, except membrane, clothed with conspicuous, appressed, pale hairs .... **pteridicola** (White).
Hemelytra, at least, naked or nearly so, at most with scattered, almost invisible, short, erect setae............... 2

2(1). Rostrum extending onto third abdominal ventrite; corium with a single dark macula near apex of vein R......... .... **nimbatus** (Kirkaldy).
Rostrum not passing second ventrite; corial maculae more numerous 3

3(2). Head with a distinct median vitta (usually reddish; rarely obscure), the insect usually with a rather conspicuous reddish cast .... **nubicola** (Kirkaldy).
Head, excepting tylus, entirely black above, not vittate; not reddish-tinged 4

4(3). Clavi and coria irregularly, confusedly maculate; sides of pronotum almost straight .... **vulcan** (White).
Clavi at most infuscated caudad; maculae of coria distinct, symmetrical, lying adjacent to membrane, usually three in number, one at base, one near middle and a smaller apical spot; sides of pronotum distinctly sinuous .... **bryani** Usinger.

Oceanides arboricola (White) (fig. 23).
Nysius arboricola White, 1878:368.
Oceanides arboricola (White) Usinger, 1942:41, pls. 2, 6.

Endemic. Oahu (type locality: none designated by White, but probably Mount Tantalus or vicinity).

Perkins (1912:732) said that this species was found abundantly "usually frequenting the branches of trees, living or dead." He also considered *nimbatus* to be a variant and a synonym.

Oceanides bimaculatus Usinger (fig. 23).
Oceanides bimaculatus Usinger, 1942:37, pl. 3, B.

Endemic. Maui (type locality: Haelaau).
Hostplant: *Alyxia.*

Oceanides bryani Usinger (fig. 23).
Oceanides bryani Usinger, 1942:28, nymph 147, pl. 2, A.

Endemic. Hawaii (type locality: Humuula).
Hostplants: *Euphorbia, Straussia hawaiiensis.*
A single egg obtained by Usinger hatched 19 days after oviposition. He describes the first nymphal instar.

Oceanides delicatus Usinger (fig. 23).
Oceanides delicatus Usinger, 1942:25, pl. 3, H.

Endemic. Oahu (type locality: Pukuloa Valley).
Hostplant: *Elaeocarpus.*

Oceanides dilatipennis Usinger (fig. 23).
Oceanides dilatipennis Usinger, 1942:43, pl. 2, B.

Endemic. Maui (type locality: Mahana).

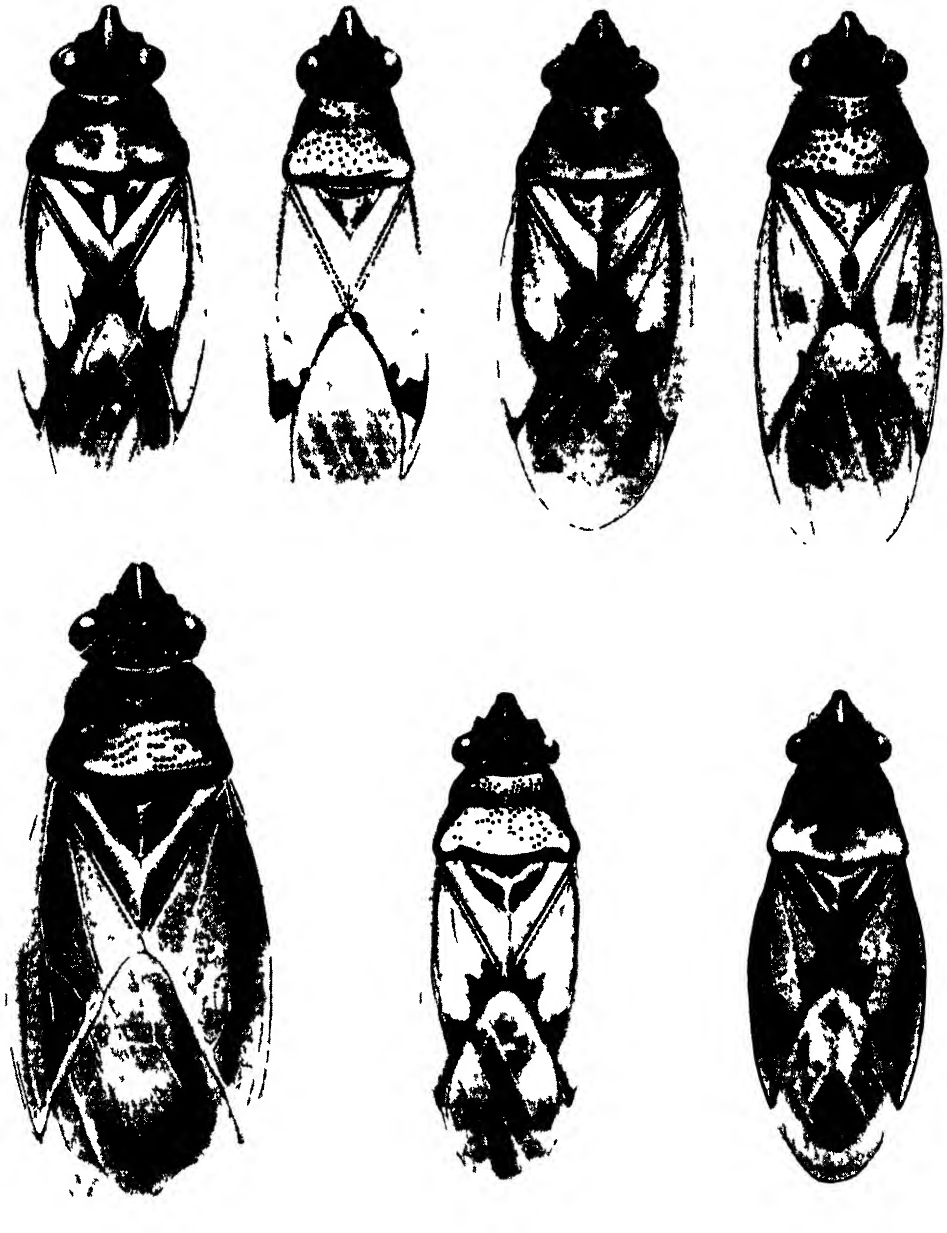


Figure 23—Some species of *Oceanides* Top row, left to right *O arboricola* (White), female, *O bimaculatus* Usinger, paratype male, *O bryani* Usinger, paratype female; *O. delicatus* Usinger, female Bottom row, left to right *O dilatipennis* Usinger, paratype female; *O fosbergi* Usinger, paratype female, *O incognitus* Usinger, holotype male (Rearranged from Usinger's original Abernathy drawings)

Oceanides fosbergi Usinger (fig. 23).
Oceanides fosbergi Usinger, 1942:31, 147 nymph; pl. 3, A.

Endemic. Lanai (type locality: Lanaihale).
Hostplants: *Coprosma, Scaevola, Straussia.*
Usinger found that the incubation period of two eggs collected was about 16 days. He described the first instar nymph.

Oceanides incognitus Usinger (fig. 23).
Oceanides incognitus Usinger, 1942:35, pl. 3, E.

Endemic. Oahu (type locality: Haleauau Valley).
Hostplants: *Myrsine, Pteralyxia.*

Oceanides membranaceus Usinger (fig. 24).
Oceanides membranaceus Usinger, 1942:34, 147, nymph; pl. 3, F.

Endemic. Oahu (type locality: Pukuloa Valley).
Hostplant: *Euphorbia.*
The last nymphal instar is described by Usinger.

Oceanides montivagus (Kirkaldy) (fig. 24).
Nysius montivagus Kirkaldy, 1910:544.
Oceanides montivagus (Kirkaldy) Usinger, 1942:21, pl. 1, C.

Endemic. Oahu, Molokai, Lanai (type locality, Perkins, 1912:734), Maui.
Hostplants: *Dodonaea, Dubautia, Metrosideros* (preferred host), *Pipturus, Sadleria.*

Oceanides myopori Usinger (fig. 24).
Oceanides myopori Usinger, 1942:26, pl. 1, F.

Endemic. Kauai (type locality: Kumuweia).
Hostplant: *Myoporum.*

Oceanides nimbatus (Kirkaldy) (figs. 21; 22, a; 24).
Nysius (Oceanides) nimbatus Kirkaldy, 1910:543. Perkins, 1912:732.
Oceanides nimbatus (Kirkaldy) Usinger, 1942:32, 148, nymph; pl. 3, G; pl. 12, A, nymph. Genotype.

Endemic. Kauai, Oahu (type locality: "Honolulu Mountains," 2,500–3,000 feet), Lanai, Maui, Hawaii.
Hostplants: *Coprosma, Broussaisia, Gouldia.*
The fifth instar nymph was described and illustrated by Usinger.

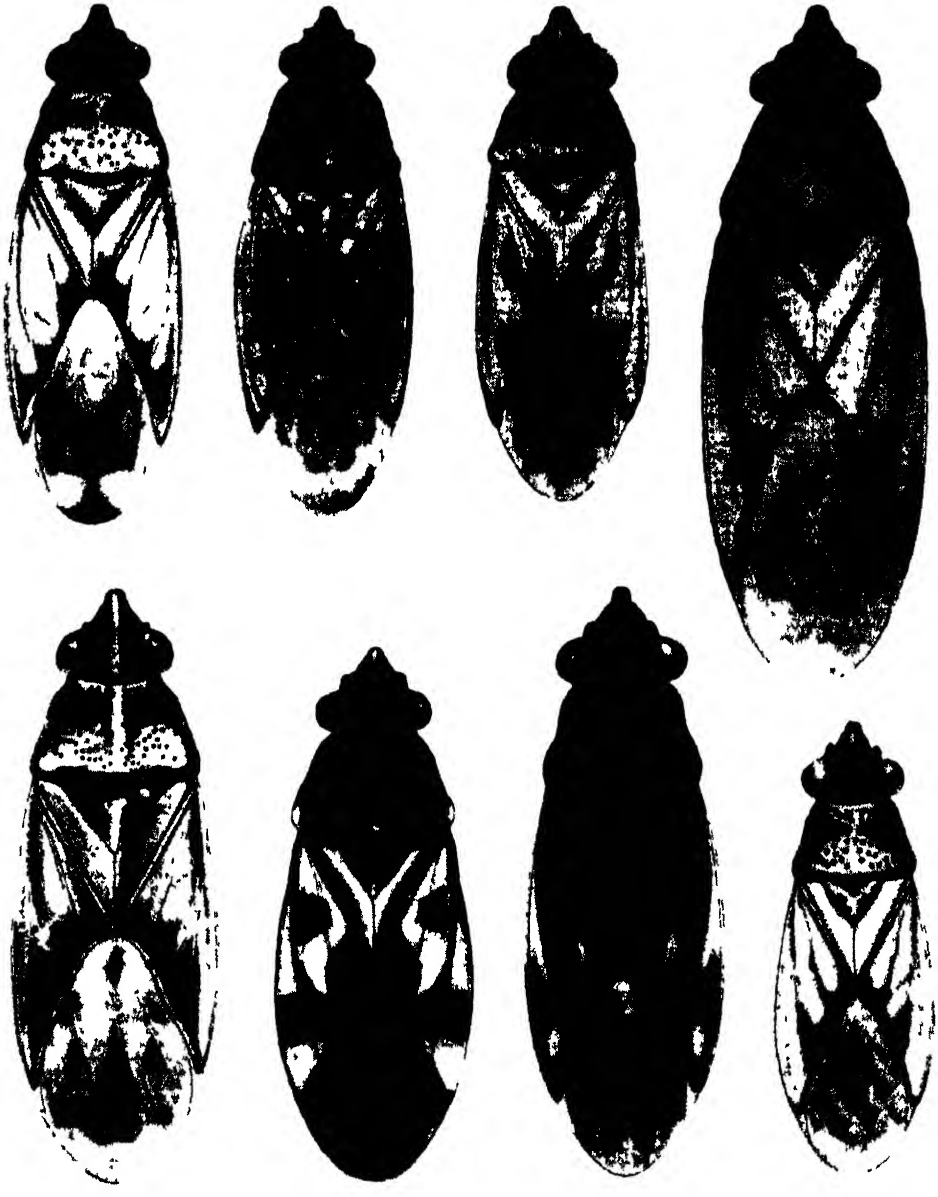


Figure 24—Species of *Oceanides* Top row, left to right · *O. membranaceus* Usinger, female; *O. montivagus* (Kirkaldy), male; *O. myopori* Usinger, female; *O. nimbatus* (Kirkaldy), female. Bottom row, left to right: *O. nubicola* (Kirkaldy), female; *O. oresitrophus* (Kirkaldy), male; *O. oribasus* (Kirkaldy), female; *O. parvulus* Usinger, allotype female. (Rearranged from Usinger's original Abernathy drawings.)

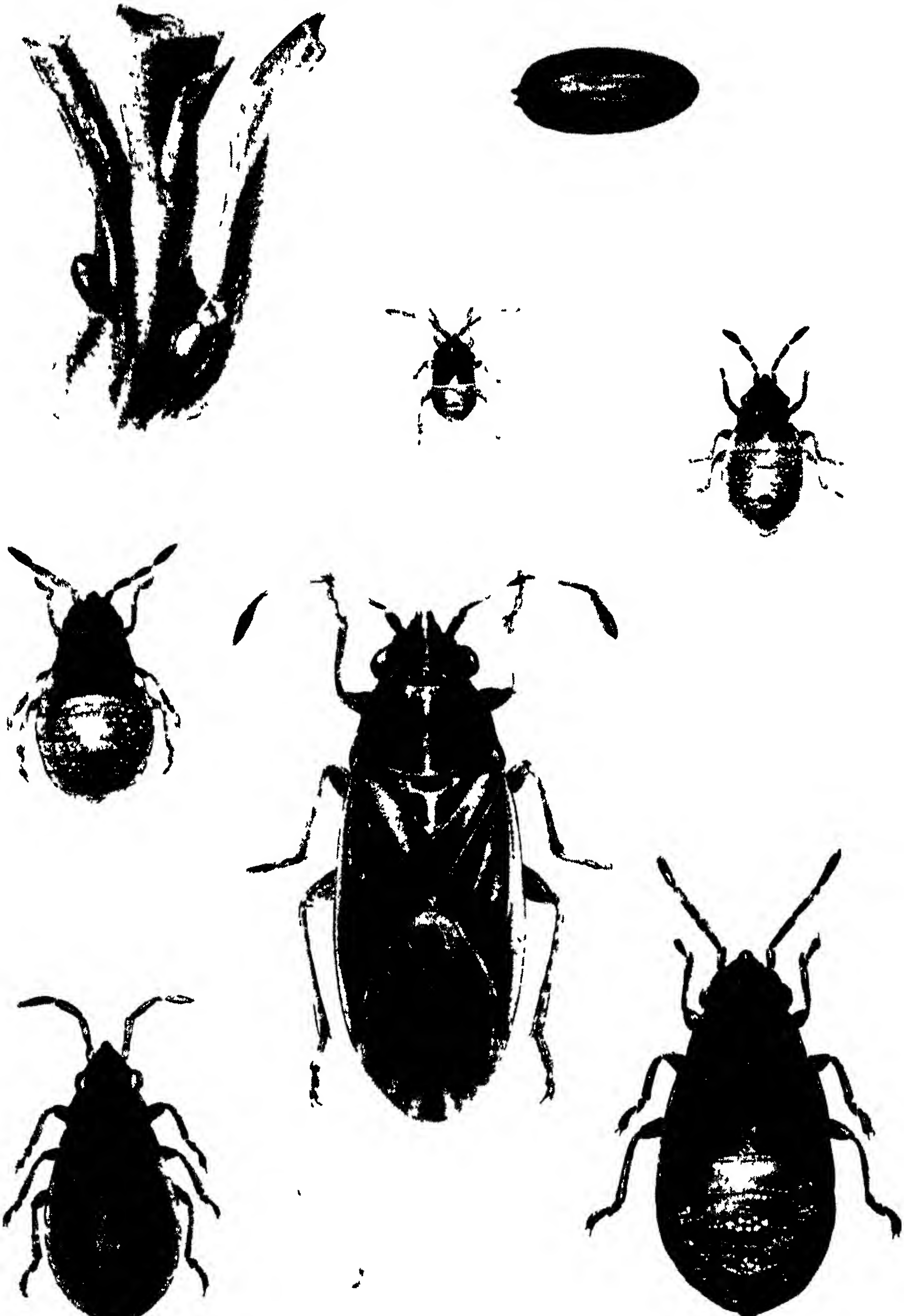


Figure 25—*Oceanides nubicola* (Kirkaldy): eggs in place on a stem of *Myoporum sandwicense*, egg (enlarged), five nymphal instars and an adult female. (After Usinger.)

Oceanides nubicola (Kirkaldy) (figs. 24, 25).
Nysius nubicola Kirkaldy, 1910:542.
Oceanides nubicola (Kirkaldy) Usinger, 1942:27, pl. 1, G.
Usinger, 1942:145–147, pl. 11 (life history), bionomics, detailed description of early stages.

Endemic. Hawaii (type locality: Kona).
Hostplant: *Myoporum sandwicense.*
Usinger gives detailed descriptions of all five nymphal instars, and he says (p. 147), "In general, the black head and thorax and ferrugineous abdomen with the transverse band of white covering basal abdominal segment will readily distinguish nymphs of this species from any other with which I am familiar." The eggs, which he found hatched in 19 or 20 days at 6,000 feet at Humuula, Hawaii, are described as follows (pp. 145–146):

Shape elongate-elliptical, broadest slightly before middle and thence gradually rounded in both directions to apices. Color rather uniform piceoferrugineous, the surface highly polished. Micropylar end with three or four white tubercles arranged as a square, rhombus, or triangle, the more closely approximated pair (where four are present) often located on the edge of a smooth, domelike elevation. In mature eggs dark eye spots may be seen just posterior to each of the lower tubercles. These, though obscure due to the dark color of the chorion, are still visible. Size: length 0.934 mm.; diameter 0.448 mm.

As in other Orsillini, hatching is accomplished by a splitting at the micropylar end so that a three-quarter circular flap acts as a lid. An embryonic membrane is then cast when the embryo quits the chorion.

Oceanides oresitrophus (Kirkaldy) (fig. 24).
Nysius oresitrophus Kirkaldy, 1910:542. Perkins, 1912:734.
Oceanides oresitrophus (Kirkaldy) Usinger, 1942:40, pl. 2, F.

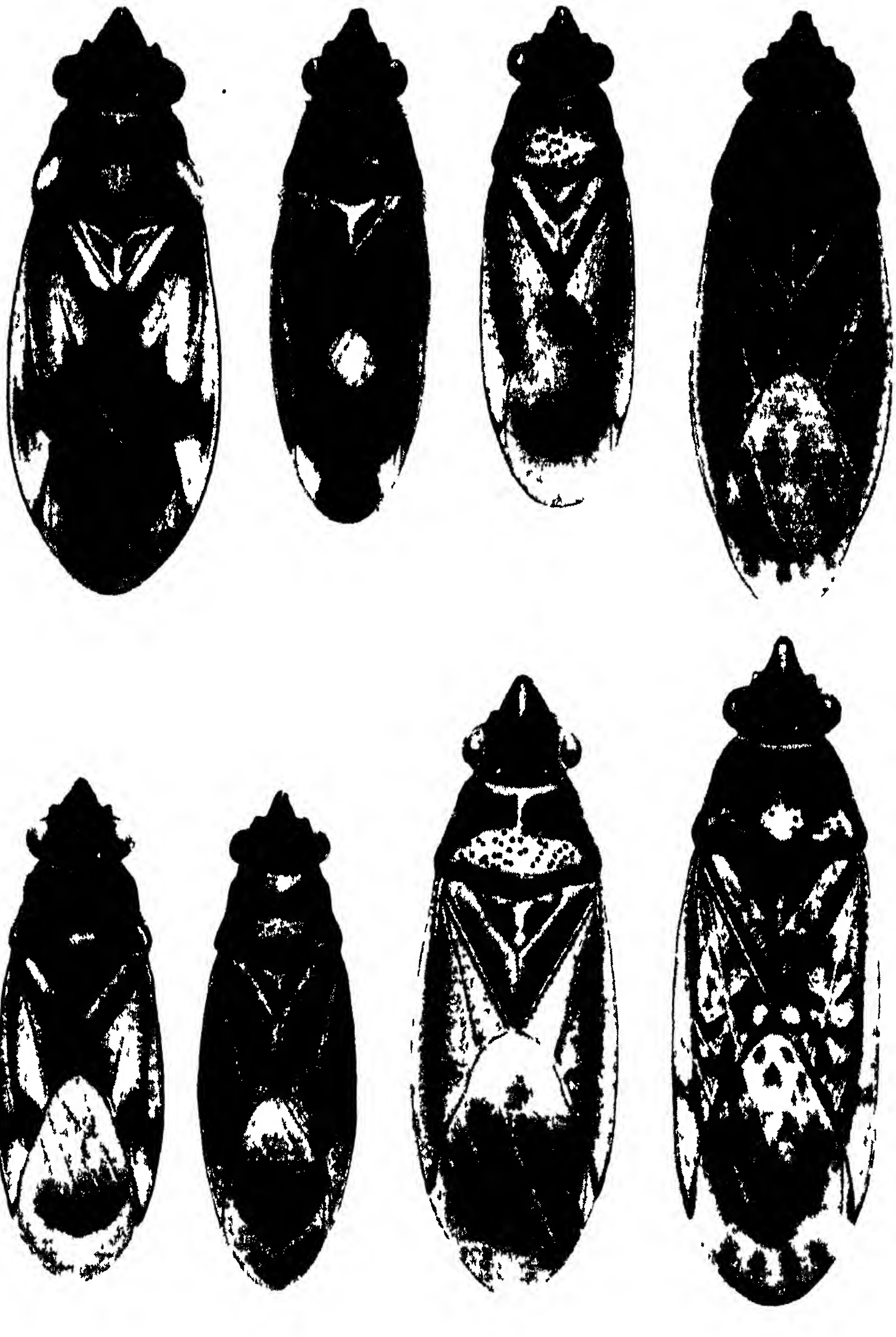
Endemic. Maui (type locality: Haleakala, over 5,000 feet).

Oceanides oribasus (Kirkaldy) (fig. 24).
Nysius oribasus Kirkaldy, 1910:544. Perkins, 1912:734.
Oceanides oribasus (Kirkaldy) Usinger, 1942:38, pl. 2, G.

Endemic. Oahu (type locality: Waialua, 2,000 feet).
Hostplants: *Elaeocarpus, Straussia.*

Oceanides parvulus Usinger (fig. 24).
Oceanides parvulus Usinger, 1942:30, pl. 3, C.

Endemic. Oahu (type locality: Manoa–Palolo Ridge).
Hostplants: *Euphorbia, Straussia kaduana.*



Oceanides perkinsi Usinger (fig. 26).
Oceanides perkinsi Usinger, 1942:42, pl. 2, H.

Endemic. Oahu (type locality: Manoa–Palolo Ridge, 2,000 feet).

Oceanides picturatus Usinger (fig. 26).
Oceanides picturatus Usinger, 1942:24, pl. 1, E.

Endemic. Oahu (type locality: Kaumuahona).
Hostplant: *Wikstroemia.*

Oceanides planicollis Usinger (fig. 26).
Oceanides planicollis Usinger, 1942:28, pl. 3, D.

Endemic. Kauai (type locality: Halemanu).
Hostplant: *Euphorbia.*

Oceanides pteridicola (White) (fig. 26).
Nysius pteridicola White, 1881:55.
Nysius insulivagus Kirkaldy, 1910:544. Synonymy by Perkins, 1912:734.
Oceanides pteridicola (White) Usinger, 1942:20, pl. 1, A.

Endemic. Maui, Hawaii (type locality: near Kilauea, 4,000 feet).
Hostplant: *Metrosideros.*

Oceanides rugosiceps Usinger (fig. 26).
Oceanides rugosiceps Usinger, 1942:37, pl. 2, E.

Endemic. Kauai (type locality: Halemanu).
Hostplant: *Pterotropia.*

Oceanides sinuatus Usinger (fig. 26).
Oceanides sinuatus Usinger, 1942:36, pl. 2, D.

Endemic. Oahu (type locality: Puu Kaua).
Hostplants: *Artemisia, Styphelia.*

Oceanides ventralis Usinger (fig. 26).
Oceanides ventralis Usinger, 1942:24, pl. 1, D.

Endemic. Kauai (type locality: Kauaikinana).
Hostplant: *Wikstroemia.*

Oceanides vulcan (White) (fig. 26).
Nysius vulcan White, 1881:56. Perkins, 1912:734.
Nysius montivagus Kirkaldy, 1910:544, in part.
Oceanides vulcan (White) Usinger, 1942:23, pl. 1, B.

Endemic. Hawaii (type locality: Mauna Loa).
Hostplant: *Metrosideros.*

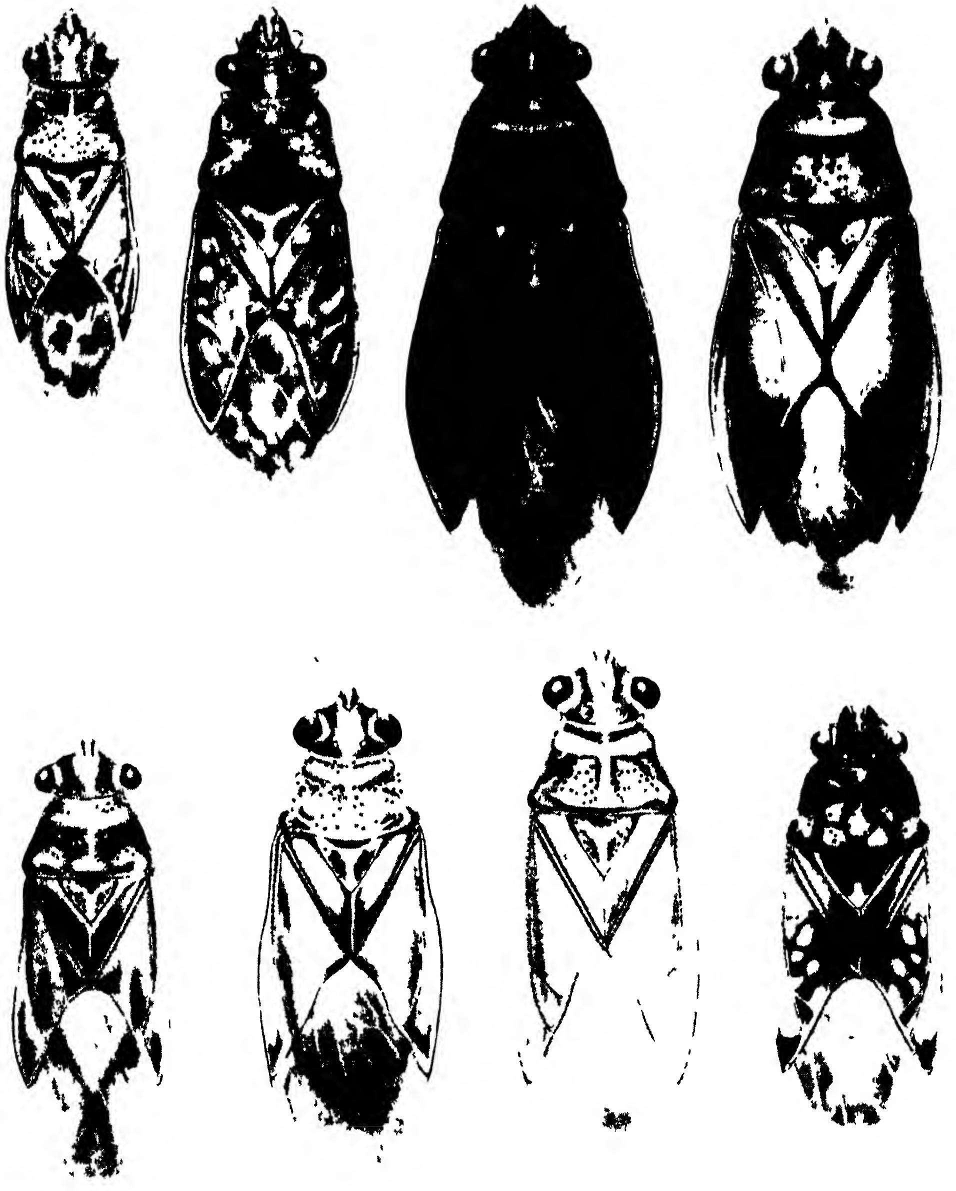


Figure 27—Some Orsillini. Top row, left to right: *Glyptonysius hylaeus* (Kirkaldy), male; *Glyptonysius laevigatus* Usinger, holotype male; *Neseis* (*Physonysius*) *ampliatus* Usinger, paratype female; *Neseis* (*Physonysius*) *molokaiensis* Usinger, paratype male. Bottom row, left to right: *Neseis* (*Leionysius*) *haleakalae* (Perkins), male; *Neseis* (*Leionysius*) *pallidus* Usinger, holotype male; *Neseis* (*Neseis*) *kirkaldyi* (Usinger), male; *Neseis* (*Trachynysius*) *alternatus* Usinger, holotype female. (Rearranged from Usinger's original Abernathy drawings.)

Genus **GLYPTONYSIUS** Usinger, 1942:44

This endemic genus was erected to include two closely allied species, one from Kauai, the other from the adjacent island of Oahu. Its members have nearly naked dorsal surfaces in common with *Neseis* and *Oceanides,* but the antenniferous tubercles are enlarged and are subcarinate on their outer dorsal edges, and the hind margin of the metapleura is concave with the lateral angles produced; the head has the derm of its dorsum wrinkled, whereas it is smooth in *Neseis.*

Usinger made much of the subcarinate antenniferous tubercles and said (1942: 119) that the species have "a distinct ridge or carina on either side of the head extending onto the antenniferous tubercles, a character unique among the described Orsillini." It has been my experience that most workers overlook this character, because it is not, in my opinion, what one would call "distinct." In fact, it is usually rather vague and is comparative in degree. I have seen some users of the text misled by the overemphasis placed upon the distinctiveness of this character.

Usinger stated (1942:123) that "*Glyptonysius* is extremely rare, only half a dozen specimens of the genus having been collected," but I found the Kauai species to be one of the more common of the Orsillini in the highlands in 1937 (my specimens were not seen by Usinger). It is strange that more specimens have not been collected.

Key to the Species of Glyptonysius

1. Kauai species; anteocular part of head equal to length of an eye; pronotum only about one-seventh broader than head; length 3.44 to 4.22 mm............**hylaeus** (Kirkaldy) Usinger.
2. Oahu species; anteocular part of head about one-third longer than an eye; pronotum about one-third broader than head; length 4.39 to 4.66 mm...................**laevigatus** Usinger.

Glyptonysius hylaeus (Kirkaldy) (fig. 27).
Nysius hylaeus Kirkaldy, 1910:539.
Glyptonysius hylaeus (Kirkaldy) Usinger, 1942:44, pl. 4, G. Genotype.

Endemic. Kauai (type locality: "Waimea Mts., 4000 ft.").

Hostplants: *Alyxia, Dubautia.*

Glyptonysius laevigatus Usinger (fig. 27).
Glyptonysius laevigatus Usinger, 1942:45, pl. 4, H.

Endemic. Oahu (type locality: Mount Tantalus, 2,000 feet).

Kirkaldy, and also Perkins (1912:735), considered this to be a variety of the Kauai form.

Genus **NESEIS** (Kirkaldy) Evans, 1929:354

This is the most complexly evolved group of Hawaiian Orsillini, for it contains, according to Usinger's treatment, 5 subgenera including 20 species, 12 subspecies and 2 varieties. Its naked or nearly naked dorsal surfaces, together with its punctate claval sutures and vein R+M, will separate it from *Nysius* and *Nesomartis;* its non-carinate, shorter antenniferous tubercles will separate it from *Glyptonysius;* and its concave posterior metapleural margin with its postero-lateral angle produced will serve to distinguish it from *Oceanides.* The head is smooth and polished in some species and rough in others.

Key to the Subgenera of Neseis

1. Eyes comparatively small, less than one-third, or about one-third, as broad as breadth of interocular area; head moderately elevated above, finely granular and clothed with an inconspicuous, subappressed, pale pubescence; body almost entirely pale yellowish to ochraceous with darker markings largely confined to head and ventral surfaces.................................. **Icteronysius** Usinger.
   Eyes larger, more than one-third as broad as breadth of interocular area; color usually darker with more distinctive dark maculations or with head smooth, polished and almost or quite naked above.......................... 2

2(1). Head roughened by minute to distinct irregular granules, punctures or wrinkles and clothed with a more or less distinct, subappressed pubescence, at least anteriorly.................................... **Trachynysius** Usinger.
   Head smooth, polished, naked above...................... 3

3(2). Costal margins strongly dilated and rounded from just before level of apex of scutellum, not subparallel even at base; corium subopaque; membrane short, scarcely exceeding tip of abdomen.............. **Physonysius** Usinger.
   Costal margins scarcely to distinctly arcuate but never before level of apex of scutellum, always subparallel subbasally; corium usually at least partially hyaline and membrane usually extending beyond apex of abdomen.............. 4

4(3). Rostrum reaching to second ventrite, its third segment about one and one-half times as long as its second and nearly twice as long as fourth................... **Neseis** Kirkaldy.
   Rostrum reaching at most to middle of metacoxae, its third segment not distinctly longer than its second and subequal in length to fourth............... **Leionysius** Usinger.

Subgenus **Physonysius** Usinger, 1942:50

Key to the Species

1. Corium dark brown to piceous with femora variegated with, or entirely, pitchy brown; Maui.............. **ampliatus** Usinger.
2. Color paler, flavous with dark-brown markings, legs pale and and often with brown-spotted femora; Molokai.. **molokaiensis** Usinger.

Neseis (Physonysius) ampliatus Usinger (fig. 27).
Neseis (*Physonysius*) *ampliatus* Usinger, 1942:51, pl. 4, I. Type of *Physonysius.*

Endemic. Maui (type locality: Mount Haleakala, over 2,000 feet).
Hostplant: *Rubus.*

Neseis (Physonysius) molokaiensis Usinger (figs. 21, 27).
Neseis (*Physonysius*) *molokaiensis* Usinger, 1942:50, pl. 4, F.

Endemic. Molokai (type locality: Mapulehu–Punaula Ridge).
Hostplant: *Freycinetia.*
The last nymphal instar is described and illustrated by Usinger (p. 149, pl. 12, C).

Subgenus **Leionysius** Usinger, 1942:52

Key to the Species

1. Pronotal disc distinctly convex caudad; distinctly maculated with fulvous and piceous, membrane embrowned on either side subbasally and at middle of apical half; size about 4.0 by 1.53 mm. .... **haleakalae** (Perkins).
2. Pronotal disc subdepressed; rather uniformly pale except for eyes and commissure of clavus, membrane concolorous; size about 4.4 by 1.8 mm. .... **pallidus** Usinger.

Neseis (Leionysius) haleakalae (Perkins) (fig. 27).
Nysius halcakalae Perkins, 1912:735.
Neseis (*Leionysius*) *haleakalae* (Perkins) Usinger, 1942:52, pl. 4, E. Type of *Leionysius.*

Endemic. Maui (type locality: Mount Haleakala, below 2,000 feet).

Neseis (Leionysius) pallidus Usinger (fig. 27).
Neseis (*Leionysius*) *pallidus* Usinger, 1942:53, pl. 4, D.

Endemic. Maui (type locality: Mount Haleakala, 9,400 feet).
Hostplant: *Styphelia.*

Subgenus **Neseis** Kirkaldy, 1910:537

Neseis (Neseis) kirkaldyi (Usinger) (fig. 27).
Nysius (*Neseis*) *monticola* Kirkaldy, 1910:544, not Distant, 1893.
Nysius kirkaldyi Usinger, 1937:443.
Neseis (*Neseis*) *kirkaldyi* (Usinger) Usinger, 1942:54, pl. 4, A. Type of subgenus.

Endemic. Maui (*type locality:* probably Mount Haleakala instead of West Maui as stated in the original description).

Hostplant: *Broussaisia.*

Subgenus **Trachynysius** Usinger, 1942:55

General Key to the Species

(Note: see also the following key, which is based upon localities.)

1. Eyes large, substylate; upper surface of head with broad, glabrous areas at middle and laterally near inner margins of eyes, these areas occupying most of upper surface of head; costal margins strongly dilated (fig. 31, *whitei*); Maui and Hawaii 2
   Eyes less strongly produced; upper surface of head with glabrous areas, when present, less extensive; costal margins less strongly dilated than in *whitei* (fig. 31) 3

2(1). Hemelytra long, membrane complete and extending beyond apex of abdomen for one-third of its length; Maui and Hawaii.................**whitei whitei** (Blackburn).
   Hemelytra strongly abbreviated, membrane extending beyond apex of abdomen for less than one-third its length; Hawaii...................**whitei brachypterus** Usinger.

3(1). Femora not spotted 4
   Femora brown- or black-spotted........................ 5

4(3). Hind femora tinged with red distad; clavus and corium mostly opaque, black except at middle of costal margin; Oahu..........................**silvestris** (Kirkaldy).
   Hind femora not tinged with red; clavus and corium hyaline, either pale or lightly infuscated, corial apices brown; Oahu ....**oahuensis** Usinger.

5(3). Largest species in genus, ranging from 5.16 mm. to 7.22 mm. in length; antennae very long, almost two-thirds longer than greatest width of pronotum behind; membrane uniformly, lightly infuscated; all high islands except Kauai................**saundersianus** (Kirkaldy).
   Usually much smaller or, if approaching in length *N. saundersianus,* either with antennae shorter, less than one-half longer than width of pronotum behind, or with membrane fuscofasciate at middle.................... 6

6(5). Femora at middle and subapically and tibiae basally, apically, and at middle with distinct, black annulations; membrane with a very few, irregular brown spots; Kauai ....**alternatus** Usinger.
   Femora brown-spotted with spots sometimes confluent and tibiae often infuscated apically but never as above....... 7

7(6). Rostrum passing posterior coxae, usually attaining second or third abdominal segment........................ 8
   Rostrum not passing posterior coxae, usually only reaching middle coxae 15

8(7). Upper surface of head comparatively smooth, with only a few wrinkles, and naked except for a few inconspicuous hairs anteriorly; color tinged with fulvous; Oahu...... .... **fulgidus** Usinger.

Upper surface of head, at least in part, rugosely punctate and with distinct, pale, appressed pubescence; color ochraceous with darker markings; all the high islands; *Neseis nitidus* subspecies 9

9(8). Size comparatively small, slender and short, 4.1 by 1.22 mm.; Oahu ....**nitidus contubernalis** Usinger.

Size always larger 10

10(9). Color almost entirely pale, ochraceous or yellowish, with pale-brown markings at apices of coria, on pronotum and on upper surface of head; pronotum typically relatively narrowed with sides feebly convex; Hawaii..... ....**nitidus comitans** (Perkins).

Color always darker, brownish-ochraceous, with more extensive black or dark-brown markings of hemelytra, pronotum and upper surface of head..................11

11(10). Pronotum relatively large and robust, distinctly longer than head on median line; broad, sides arcuate throughout their length except for a slight sinuation just behind callosities; humeral angles broadly rounded; Molokai.... ....**nitidus consummatus** Usinger.

Pronotum smaller, subequal in length to head or, if slightly longer, with sides almost straight, only feebly ampliate at level of callosities, and humeral angles more abruptly rounded 12

12(11). Kauai form; pronotum relatively short and broad, about as long as head.............**nitidus impressicollis** Usinger.

Not Kauai forms; pronotum longer than head............13

13(12). Maui form......................**nitidus nitidus** (White).

Not so 14

14(13). Lanai form....................**nitidus insulicola** Usinger.

Hawaii form ....**nitidus pipturi** Usinger.

15(7). Head comparatively short, anteocular portion only two-thirds as long as an eye.............................16

Head longer, produced in front of eyes for a distance greater than two-thirds length of an eye...............20

16(15). Pronotum strongly narrowed anteriorly, scarcely more ampliate at level of callosities; disc strongly convex behind transverse impression, posterior lobe distinctly, longitudinally fasciate at middle and sublaterally; costal margins scarcely convergent posteriorly; Hawaii and Lanai; *Neseis fasciatus* subspecies...................17

Pronotum more nearly subquadrate, lateral margins turned outward a little at level of callosities; disc only moderately convex or subflattened on posterior lobe and with only the usual brown spots at humeral angles and middle of posterior margin; Maui; *Neseis mauiensis* varieties 19

17(16). Pronotal disc strongly convex on posterior lobe; Lanai.. .... **fasciatus convergens** Usinger.
Pronotal disc only moderately convex on posterior lobe; Hawaii 18

18(17). Clavus and corium pale, subhyaline.................. .... ***fasciatus hyalinus*** *Usinger.*
Clavus and corium in great part dark brown or black, subopaque.................. **fasciatus fasciatus** Usinger.

19(16). Color in great part fuscous to black, callosities usually black; corium broadly infuscated, dark brown to black .... **mauiensis mauiensis** (Blackburn).
Color much paler, callosities sometimes brown; usually with a longitudinal pale line at middle of interocular region; corium infuscated only interruptedly on veins and narrowly at apex........... **mauiensis pallidipennis** Usinger.

20(15). Female genital cleft shallow, fourth visible ventral segment about half length of third at middle; body form relatively short and broad (35 to 38 percent as broad across hemelytra as long), appearing robust throughout; costal margins distinctly arcuate behind level of apex of scutellum, or more slender with costal margins more gradually arcuate throughout 21
Female genital cleft deeper, fourth visible ventral segment nearly concealed or concealed beneath third at middle; body more slender (31 to 33 percent as broad across hemelytra as long), sides subparallel; costal margins of coria only feebly arcuate beyond apex of scutellum......23

21(20). Costal margins scarcely sinuate subbasally and at level of apex of scutellum, otherwise moderately evenly arcuate; ground color, including upper surface of head, pale brown; pronotum extensively, distinctly punctate on posterior lobe; Molokai................. **cryptus** Usinger.
Costal margins distinctly dilated beyond level of apex of scutellum; ground color reddish or ochraceous with black upper surface of head and other maculations............22

22(21). Size large, 4.7 to 5.3 mm.; distinctly tinged with red, clavus brown only narrowly on commissure, and corium brown only near outer apical angle; Molokai..... **swezeyi** Usinger.
Size smaller, 4.25 to 4.5 mm.; brownish-ochraceous marked with black on apical third of clavus and on inner apical portion of corium between vein Cu and clavus, and on inner apical portion of corium between vein Cu and claval suture; Molokai.................. **chinai** Usinger.

23(20). Eyes small, distinctly less than half width of interocular space (eyes measured to inner line of ommatidia); juga very large; their outer sides, as viewed from above, nearly or distinctly convex; Oahu, Molokai..................24
Eyes larger, nearly half as wide as interocular space; juga with concave side margins; Hawaii, Maui..............25

24(23). Eyes measured from inner row of ommatidia only slightly if any wider than one-third breadth of interocular area;

pronotum with a dark vitta on median line and between median line and sides; first rostral segment reaching only about as far back as fore part of eye; Oahu......... ....**hiloensis jugatus** Usinger.

Eyes distinctly more than one-third as broad as interocular area; pronotum not vittate; first rostral segment nearly reaching base of head......**hiloensis interoculatus** Usinger.

25(23). Small (3.54 to 4.22 mm. by 1.28 to 1.44 mm.), slender, pale species; markings pale brown and confined to apices of coria, membrane, humeral angles and middle of posterior margin of pronotum; Hawaii.................. ....**hiloensis hiloensis** (Perkins).

Larger, proportionately broader, and ochraceous with more extensive dark fuscous to black markings on hemelytra...26

26(25). Anteocular part of head very nearly as long as an eye; interocular space a little elevated along middle; lateral margins of pronotum moderately but distinctly ampliate at level of callosities; Maui........................ ....**hiloensis approximatus** Usinger.

Anteocular part of head distinctly shorter than an eye; interocular space subdepressed and flattened; lateral margins of pronotum almost straight, scarcely ampliate at level of callosities; Hawaii...**hiloensis intermedius** Usinger.

Because the species and lesser forms of *Trachynysius* are difficult to distinguish, I have felt it desirable to prepare a second key in which geographical distribution has been used as a primary character to split the assemblage into small groups. Excepting *saundersianus,* each of the forms is restricted to a single island. Hence, the reader may find this second set of keys of considerable help in more quickly determining a collection of specimens from a single locality.

Island Keys for the Separation of the Forms of Trachynysius

SECTION A—KEY TO THE KAUAI TRACHYNYSIUS

1. Legs with spots condensed to form black annulations at middle and subapically on femora, basad, mesad and distad on tibiae; rostrum reaching posterior coxae........ .... **alternatus** Usinger.

2. Legs with many distinct spots, but not banded; rostrum reaching far behind metacoxae..................... ....**nitidus impressicollis** Usinger.

SECTION B—KEY TO THE OAHU TRACHYNYSIUS

1. Femora not spotted 2

Femora with distinct dark spots........................ 3

2(1). Hind femora tinged with red distad; clavus and corium mostly opaque, black, except at middle of costal margins ....**silvestris** (Kirkaldy).

Hind femora not tinged with red; clavus and corium hyaline, either pale or lightly infuscated, corial apices brown ....**oahuensis** Usinger.

3(1). A large species, 5.16 to 7.22 mm. long; antennae elongate, about two-thirds longer than greatest pronotal breadth; wing membrane uniformly, lightly infuscated .... **saundersianus** (Kirkaldy).
Smaller species with antennae less than one-half longer than greatest pronotal breadth, and/or with wing membrane fusco-fasciate at middle 4

4(3). Rostrum reaching only middle coxae or hind coxae, but not surpassing hind coxae .... **hiloensis jugatus** Usinger.
Rostrum extending behind metacoxae 5

5(4). Dorsum of head comparatively smooth and bare except for a few inconspicuous hairs anteriorly; color tinged with fulvous .... **fulgidus** Usinger.
Dorsum of head, at least in part, rugosely sculptured and with distinct, pale, appressed pubescence; color ochraceous with darker markings ... **nitidus contubernalis** Usinger.

SECTION C—KEY TO THE MOLOKAI TRACHYNYSIUS

1. A large species, 5.16 to 7.22 mm. long; antennae elongate, about two-thirds longer than greatest pronotal breadth: wing membrane uniformly lightly infuscated .... **saundersianus** (Kirkaldy).
Smaller species with antennae less than one-half longer than greatest pronotal breadth, and/or with wing membrane fusco-fasciate at middle 2

2(1). Rostrum extending behind metacoxae .... **nitidus consummatus** Usinger.
Rostrum reaching meso- or metacoxae, but not extending behind metacoxae 3

3(2). Female genital cleft deep, fourth visible ventral segment nearly concealed or concealed beneath third at middle; body comparatively slender (31 to 33 percent as broad across hemelytra as long), sides subparallel; costal margins of coria only feebly arcuate beyond apex of scutellum .... **hiloensis interoculatus** Usinger.
Female genital cleft shallower, fourth visible ventral segment about half length of third at middle 4

4(3). Costal margins scarcely sinuate subbasally and at level of apex of scutellum, otherwise moderately evenly arcuate; ground color, including upper surface of head, pale brown; pronotum extensively distinctly punctate on posterior lobe .... **cryptus** Usinger.
Costal margins distinctly dilated beyond level of apex of scutellum; ground color reddish or ochraceous with black upper surface of head and other maculations 5

5(4). Length 4.7 to 5.3 mm.; distinctly tinged with reddish, clavus brown only narrowly on commissure and corium brown only near outer apical angle .... **swezeyi** Usinger.
Length shorter, 4.27 to 4.5 mm.; brownish-ochraceous marked with black on apical third of clavus and on inner apical portion of corium between vein Cu and claval suture .... **chinai** Usinger.

SECTION D—KEY TO THE LANAI TRACHYNYSIUS

1. A large species, 5.16 to 7.22 mm. long; antennae elongate, about two-thirds longer than greatest pronotal breadth; hemelytral membrane uniformly lightly infuscated...... .... **saundersianus** (Kirkaldy).
   Smaller species with antennae less than one-half longer than greatest pronotal breadth, and/or with hemelytral membrane fusco-fasciate at middle..................... 2
2. Rostrum extending to about middle of second abdominal sternite; pronotum not vittate..**nitidus insulicola** (Kirkaldy)
   Rostrum not reaching metacoxae; pronotum vittate....... ....**fasciatus convergens** Usinger.

SECTION E—KEY TO THE MAUI TRACHYNYSIUS

1. A large species, 5.16 to 7.22 mm. long; antennae elongate, about two-thirds longer than greatest pronotal breadth; hemelytral membrane uniformly lightly infuscated...... ....**saundersianus** (Kirkaldy).
   Smaller species with antennae less than one-half longer than greatest pronotal breadth, and/or with hemelytral membrane fusco-fasciate at middle..................... 2

2(1). Rostrum extending behind metacoxae..**nitidus nitidus** (White).
   Rostrum not reaching hind margin of metacoxae........... 3

3(2). Anteocular part of head more than two-thirds as long as an eye...................**hiloensis approximatus** Usinger.
   Head short, anteocular part only about two-thirds as long as an eye 4

4(3). Mostly fuscous to black, pronotal callosities usually black, corium broadly infuscated, dark brown to black........ ....**mauiensis mauiensis** (Blackburn).
   Paler forms, pronotal callosities sometimes brown, usually with a longitudinal pale line at middle of interocular region, corium infuscated only interruptedly on veins and narrowly at apex......**mauiensis pallidipennis** Usinger.

SECTION F—KEY TO THE HAWAII TRACHYNYSIUS

1. Eyes large, substylate; upper surface of head with broad, glabrous areas at middle and laterally near inner margins of eyes, these areas occupying most of upper surface of head; costal margins strongly dilated (fig. 31, *whitei*)..... 2
   Eyes less strongly produced; upper surface of head with glabrous areas, when present, less extensive; costal margins less strongly dilated (fig. 30, *saundersianus,* for example) 3

2(1). Hemelytra long, membrane complete and exceeding tip of abdomen by one-third its length...**whitei whitei** (Blackburn).
   Hemelytra strongly abbreviated, membrane exceeding tip of abdomen by less than one-third its length........... ....**whitei brachypterus** Usinger.

3(1). A large species, 5.16 to 7.22 mm. long; antennae elongate, about two-thirds longer than greatest pronotal breadth; hemelytral membrane uniformly lightly infuscated.. **saundersianus** (Kirkaldy).
Smaller species with antennae less than one-half longer than greatest pronotal breadth, and/or with hemelytral membrane fusco-fasciate at middle..................... 4

4(3). Rostrum extending behind metacoxae..................... 5
Rostrum not reaching beyond metacoxae.................. 6

5(4). Predominantly pale species, mostly yellow, dark coloring on crown of head brown, not even base black......................................**nitidus comitans** (Perkins).
Pale brown to ochraceous species, dark coloring on crown of head black or brown with at least some black basad...**nitidus pipturi** Usinger.

6(4). Anteocular area of head only about two-thirds length of an eye; pronotum usually multi-vittate or subvittate......... 7
Anteocular area of head more than two-thirds length of an eye; pronotum not vittate............................. 8

7(6). Clavus and corium for most part dark...**fasciatus fasciatus** Usinger.
Clavus and corium mostly pale.....**fasciatus hyalinus** Usinger.

8(6). Sides of pleura brown, not black; abdomen not extensively black.......................**hiloensis hiloensis** (Perkins).
Sides of pleura black, not brown; abdomen with extensive black coloring..............**hiloensis intermedius** Usinger.

Neseis (Trachynysius) alternatus Usinger (fig. 27).
Neseis (Trachynysius) alternatus Usinger, 1942:76, pl. 6, F.

Endemic. Kauai (type locality: Halemanu).
Hostplant: *Pterotropia.*

Neseis (Trachynysius) chinai Usinger (fig. 28).
Neseis (Trachynysius) chinai Usinger, 1942:78, pl. 5, E.

Endemic. Molokai (type locality: Mapulehu–Punaula Ridge).

Neseis (Trachynysius) cryptus Usinger (fig. 28).
Neseis (Trachynysius) cryptus Usinger, 1942:58, pl. 5, A.

Endemic. Molokai (type locality: Mapulehu Valley).

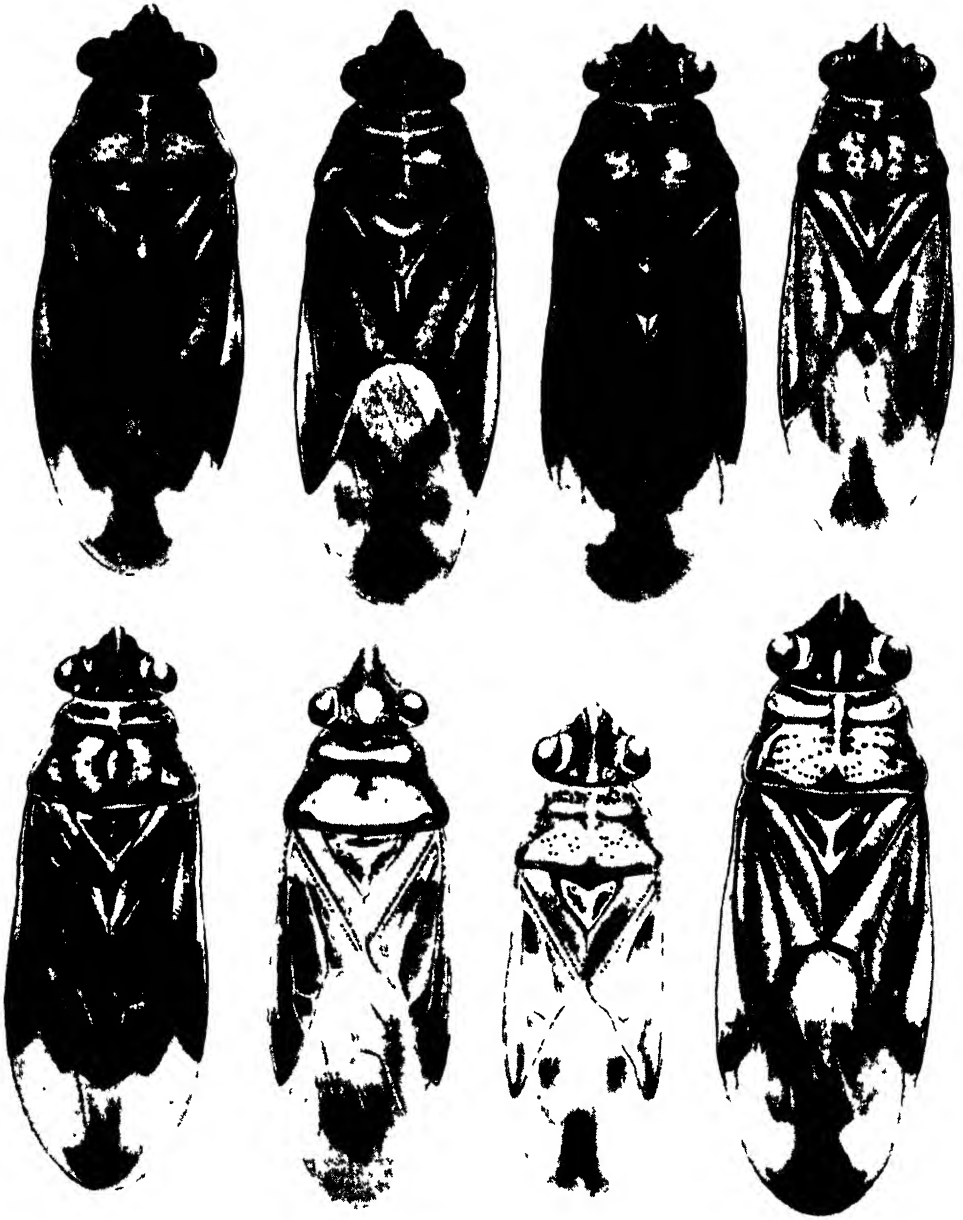


Figure 28—Some species of *Nesis* (*Trachynysius*) Top row, left to right: *N.* (*T.*) *chinai* Usinger, paratype female; *N.* (*T.*) *cryptus* Usinger, holotype female; *N.* (*T.*) *fasciatus fasciatus* Usinger, allotype female; *N.* (*T.*) *fasciatus fasciatus hyalinus* Usinger, holotype male. Bottom row, left to right: *N.* (*T.*) *fasciatus convergens* Usinger, allotype female; *N.* (*T.*) *fulgidus* Usinger, paratype female; *N.* (*T.*) *hiloensis hiloensis* (Perkins), male; *N.* (*T.*) *hiloensis approximatus* Usinger, allotype female. (Rearranged from Usinger's original Abernathy drawings)

Neseis (Trachynysius) fasciatus fasciatus Usinger (figs. 21, 28).
Neseis (Trachynysius) fasciatus fasciatus Usinger, 1942:80, pl. 6, A.

Endemic. Hawaii (type locality: Kilauea).
Hostplants: *Coprosma, Myrsine, Straussia.*
The last nymphal instar was figured and described by Usinger, p. 151, pl. 12, D.

Neseis (Trachynysius) fasciatus fasciatus hyalinus Usinger (fig. 28).
Neseis (Trachynysius) fasciatus fasciatus variety *hyalinus* Usinger, 1942:81, pl. 6, B.

Endemic. Hawaii (type locality: North Kona, 3,790 feet).
Hostplants: *Coprosma, Pelea, Straussia.*

Neseis (Trachynysius) fasciatus convergens Usinger (fig. 28).
Neseis (Trachynysius) fasciatus subspecies *convergens* Usinger, 1942:81, pl. 6, C.

Endemic. Lanai (type locality).

Neseis (Trachynysius) fulgidus Usinger (figs. 21, 28).
Neseis (Trachynysius) fulgidus Usinger, 1942:59, pl. 5, B.

Endemic. Oahu (type locality: mountains above Punaluu).
Hostplants: *Coprosma, Pipturus.*
Usinger described and figured the last nymphal instar (p. 150, pl. 12, E).

Neseis (Trachynysius) hiloensis hiloensis (Perkins) (fig. 28).
Nysius hiloensis Perkins, 1912:735.
Neseis (Trachynysius) hiloensis hiloensis (Perkins) Usinger, 1942:72, pl. 6, I.

Endemic. Hawaii (type locality: "Hilo, about 1200 ft.").

Neseis (Trachynysius) hiloensis approximatus Usinger (fig. 28).
Neseis (Trachynysius) hiloensis subspecies *approximatus* Usinger, 1942:70, pl. 6, H.

Endemic. Maui (type locality: Waihee Valley, 50 feet).
Hostplants: *Pipturus, Sideroxylon.*

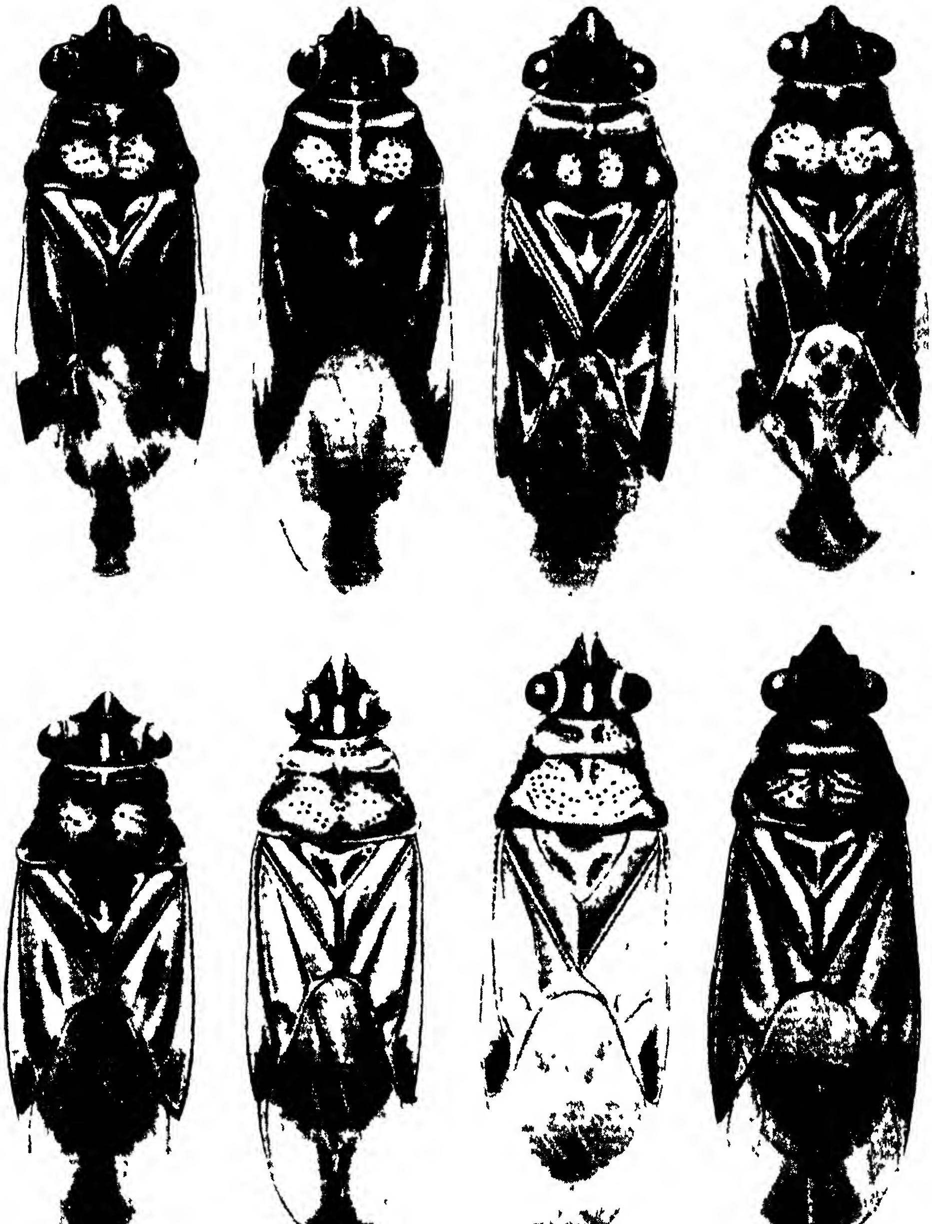


Figure 29—Some *Neseis* (*Trachynysius*). Top row, left to right: *N.* (*T.*) ***hiloensis intermedius*** Usinger, paratype male, *N.* (*T.*) ***hiloensis interoculatus*** Usinger, holotype female; *N.* (*T.*) ***hiloensis jugatus*** Usinger, female; *N.* (*T*) ***mauiensis mauiensis*** (Blackburn), female. Bottom row, left to right: *N.* (*T.*) ***mauiensis pallidipennis*** Usinger, holotype male; *N.* (*T.*) ***nitidus nitidus*** (White), male; *N.* (*T*) ***nitidus comitans*** (Perkins), female; *N.* (*T.*) ***nitidus consummatus*** Usinger, holotype male. (Rearranged from Usinger's original Abernathy drawings.)

Neseis (Trachynysius) hiloensis intermedius Usinger (fig. 29).
Neseis (Trachynysius) hiloensis subspecies *intermedius* Usinger, 1942:71, pl. 6, J.

Endemic. Hawaii (type locality: Kilauea).
Hostplants: *Pipturus,* ferns.

Neseis (Trachynysius) hiloensis interoculatus Usinger (fig. 29).
Neseis (Trachynysius) hiloensis subspecies *interoculatus* Usinger, 1942:69, pl. 6, K.

Endemic. Molokai (type locality: Mapulehu–Punaula Ridge).
Hostplant: *Pipturus.*

Neseis (Trachynysius) hiloensis jugatus Usinger (fig. 29).
Neseis (Trachynysius) hiloensis subspecies *jugatus* Usinger, 1942:68, pl. 6, L.

Endemic. Oahu (type locality: mountains behind Punaluu).
Hostplant: *Pipturus.*

Neseis (Trachynysius) mauiensis mauiensis (Blackburn) (fig. 29).
Nysius mauiensis Blackburn, 1888:345.
Neseis (Trachynysius) mauiensis mauiensis (Blackburn) Usinger, 1942:79, pl. 6, E.
Kirkaldy, 1908:190; 1910:538. Perkins, 1912:732, misspelled *maniensis.*

Endemic. Maui (type locality: Mount Haleakala, 4,500 feet).
Hostplants: *Cheirodendron, Clermontia arborescens, Coprosma, Pelea, Rubus.*
Perkins recorded this species from Hawaii and Lanai, but Usinger lists it as confined to Maui.

Neseis (Trachynysius) mauiensis pallidipennis Usinger (fig. 29).
Neseis (Trachynysius) mauiensis variety *pallidipennis* Usinger, 1942:80, pl. 6, D.

Endemic. Maui (type locality: Waikamoi).

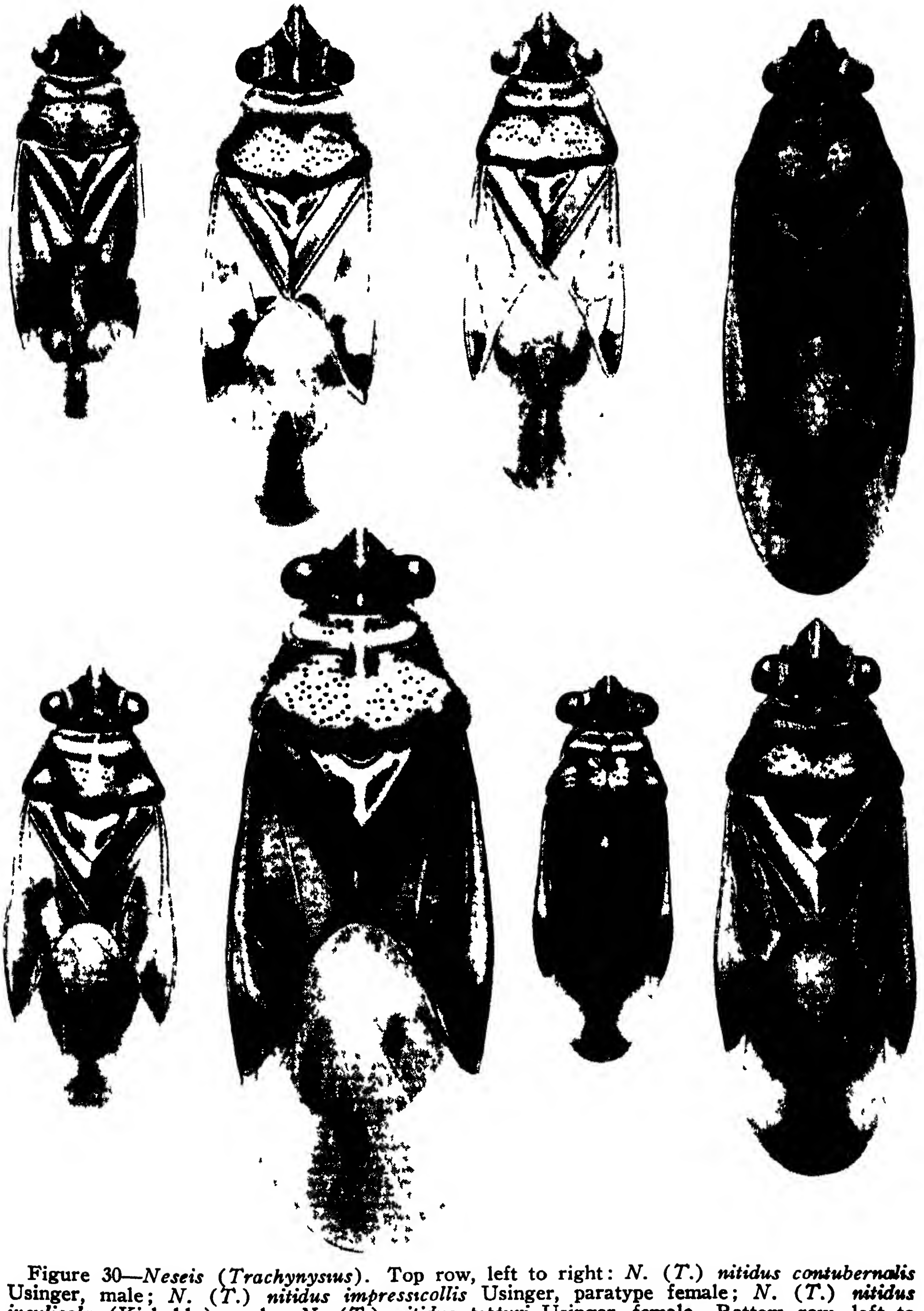


Figure 30—*Neseis* (*Trachynysius*). Top row, left to right: *N.* (*T.*) *nitidus contubernalis* Usinger, male; *N.* (*T.*) *nitidus impressicollis* Usinger, paratype female; *N.* (*T.*) *nitidus insulicola* (Kirkaldy), male; *N.* (*T.*) *nitidus pipturi* Usinger, female. Bottom row, left to right: *N.* (*T.*) *oahuensis* Usinger, paratype female; *N.* (*T.*) *saundersianus* (Kirkaldy), male; *N.* (*T.*) *silvestris* (Kirkaldy), male; *N.* (*T.*) *swezeyi* Usinger, female. (Rearranged from Usinger's original Abernathy drawings.)

Neseis (Trachynysius) nitidus nitidus (White) (fig. 29).
Nysius nitidus White, 1881:53. Kirkaldy, 1908:190; 1910:543. Perkins, 1912:732.
Neseis (Trachynysius) nitidus nitidus (White) Usinger, 1942:64, pl. 7, G.

Endemic. Maui (type locality: Haleakala, 4,000 feet).
Hostplants: *Pipturus* (?), *Urera.*

Neseis (Trachynysius) nitidus comitans (Perkins) (fig. 29).
Nysius comitans Perkins, 1912:736.
Neseis (Trachynysius) nitidus subspecies *comitans* (Perkins) Usinger, 1942:66, pl. 7, A.

Endemic. Hawaii (type locality: "Hilo, about 1200 ft.").
Hostplant: *Pipturus.*

Neseis (Trachynysius) nitidus consummatus Usinger (fig. 29).
Neseis (Trachynysius) nitidus subspecies *consummatus* Usinger, 1942:62, pl. 7, C.

Endemic. Molokai (type locality: Mapulehu–Punaula Ridge).

Neseis (Trachynysius) nitidus contubernalis Usinger (fig. 30).
Neseis (Trachynysius) nitidus subspecies *contubernalis* Usinger, 1942:61, pl. 7, B.

Endemic. Oahu (type locality: mountains behind Punaluu).
Hostplant: *Pipturus.*

Neseis (Trachynysius) nitidus impressicollis Usinger (fig. 30).
Neseis (Trachynysius) nitidus subspecies *impressicollis* Usinger, 1942:60, pl. 7, D.

Endemic. Kauai (type locality: Kumuweia).
Hostplants: *Cyrtandra, Dodonaea, Osmanthus, Pipturus.*

Neseis (Trachynysius) nitidus insulicola (Kirkaldy) (fig. 30).
Nysius insulicola Kirkaldy, 1910:541.
Neseis (*Trachynysius*) *nitidus* subspecies *insulicola* (Kirkaldy) Usinger, 1942:63, pl. 7, E.

Endemic. Lanai (type locality: "over 2000 ft.").

Neseis (Trachynysius) nitidus pipturi Usinger (fig. 30).
Neseis (*Trachynysius*) *nitidus* subspecies *pipturi* Usinger, 1942:65, pl. 7, F.

Endemic. Hawaii (type locality: Kilauea).
Hostplant: *Pipturus.*
Usinger described the fifth nymphal instar (p. 151).

Neseis (Trachynysius) oahuensis Usinger (fig. 30).
Neseis (*Trachynysius*) *oahuensis* Usinger, 1942:57, pl. 5, C.
Endemic. Oahu (type locality: Manoa–Palolo Ridge).

Hostplant: *Boehmeria grandis.*
The egg and first nymphal instar have been described by Usinger (p. 150).

Neseis (Trachynysius) saundersianus (Kirkaldy) (figs. 22, c; 30).
Nysius saundersianus Kirkaldy, 1902:163; 1908:189; 1910:537.
Nysius saundersi, misspelling by Perkins, 1913:cxcv.
Neseis (*Trachynysius*) *saundersianus* (Kirkaldy) Usinger, 1942:74, pl. 5, F.

Endemic. Oahu, Molokai, Lanai, Maui, Hawaii. (No type locality designated.)
Hostplants: *Broussonetia, Claoxylon, Coprosma, Freycinetia, Sapindus, Urera.*

Neseis (Trachynysius) silvestris (Kirkaldy) (fig. 30).
Nysius silvestris Kirkaldy, 1910:541.
Neseis (*Trachynysius*) *silvestris* (Kirkaldy) Usinger, 1942:77, pl. 6, G.

Endemic. Oahu (type locality: "Waianae Mts., about 3000 ft.").
Hostplant: *Straussia.*

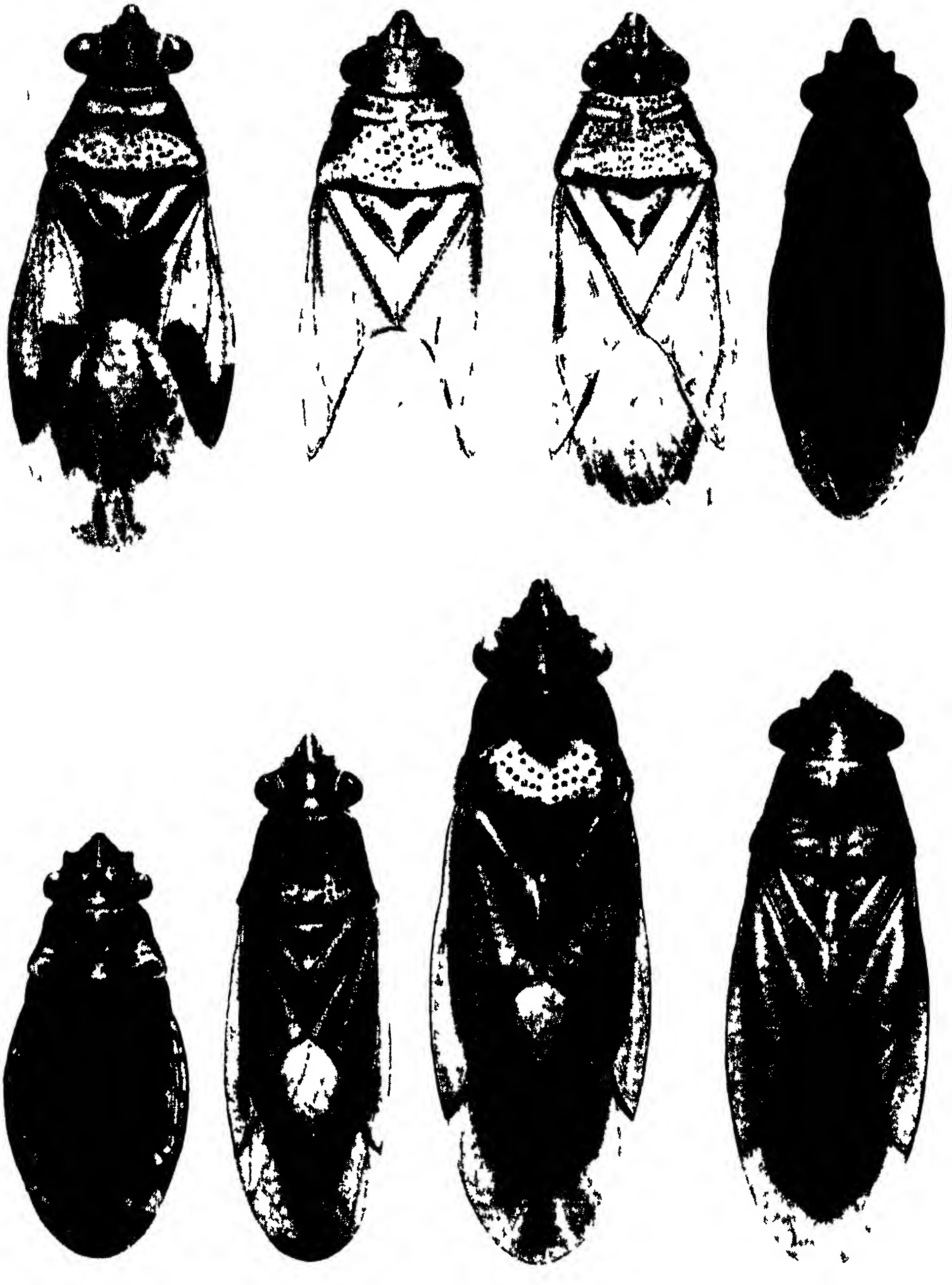


Figure 31—Some Orsillini. Top row, left to right: *Neseis (Trachynysius) whitei whitei* (Blackburn), female; *Neseis (Icteronysius) ochriasis ochriasis* (Kirkaldy), female; *Neseis (Icteronysius) ochriasis maculiceps* (Usinger), female; *Nysius abnormis* Usinger, holotype male. Bottom row, left to right: *Nysius blackburni* White, female; *Nysius coenosulus* Stål, male; *Nysius communis* Usinger, female; *Nysius dallasi* White, female. (Rearranged from Usinger's original Abernathy drawings.)

Neseis (Trachynysius) swezeyi Usinger (fig. 30).
Neseis (Trachynysius) swezeyi Usinger, 1942:73, pl. 5, G.

Endemic. Molokai (type locality: Mapulehu–Punaula Ridge).
Hostplant: *Pipturus.*

Neseis (Trachynysius) whitei whitei (Blackburn) (fig. 31).
Nysius whitei Blackburn, 1888:346. Kirkaldy, 1908:190; 1910:538. Perkins, 1912:733, redescription.
Neseis (Trachynysius) whitei whitei (Blackburn) Usinger, 1942:55, pl. 5, D.

Endemic. Hawaii (type locality, Mauna Loa, 4,000 feet).

Neseis (Trachynysius) whitei brachypterus Usinger (fig. 32).
Neseis (Trachynysius) whitei subspecies *brachypterus* Usinger, 1942:56.

Endemic. Hawaii (type locality: Nauhi Gulch, 5,000–6,000 feet).
Hostplant: *Astelia.*
The shortening of the wings of this species is a noteworthy evolutionary tendency.

Figure 32—*Neseis (Icteronysius) ochriasis baldwini* Usinger, allotype female, left. *Neseis (Trachynysius) whitei brachypterus* Usinger, paratype female, right.

Subgenus **Icteronysius** Usinger, 1942:82

Usinger, 1945:405, notes.

Key to the Subspecies

1. Maui form........................**ochriasis baldwini** Usinger.
   Hawaii forms 2
2. Rostrum only reaching middle of metacoxae; head maculations ill-defined, pale brown.........**ochriasis ochriasis** (Kirkaldy).
   Rostrum extending to about middle of ventrite two; head maculations prominent, black......**ochriasis maculiceps** (Usinger).

Neseis (Icteronysius) ochriasis ochriasis (Kirkaldy) (fig. 31).
Nysius ochriasis Kirkaldy, 1902:162; 1910:541. Perkins, 1912:734.
Neseis (*Icteronysius*) *ochriasis* (Kirkaldy) Usinger, 1942:83, pl. 4, C.
Neseis (*Icteronysius*) *ochriasis ochriasis* (Kirkaldy) Usinger, 1945:405. Type of *Icteronysius*.

Endemic. Hawaii (type series from Hualalai, 8,000 feet, and Kilauea).
Hostplants: *Dubautia, Raillardia, Sophora, Pelea.* Perhaps all these plants except *Sophora* were recorded from accidental captures and are not true hosts.

Neseis (Icteronysius) ochriasis baldwini Usinger (fig. 32).
Neseis (*Icteronysius*) *ochriasis* subspecies *baldwini* Usinger, 1945:405.

Endemic. Maui (type locality: Waikekeehia, Mount Haleakala, 6,300 feet).
Hostplant: *Sophora.*

Neseis (Icteronysius) ochriasis maculiceps (Usinger) (figs. 21, 31).
Neseis (*Icteronysius*) *maculiceps* Usinger, 1942:84, pl. 4, B.
Neseis (*Icteronysius*) *ochriasis* subspecies *maculiceps* (Usinger) Usinger, 1945:405.

Endemic. Hawaii (type locality: Humuula, about 8,000 feet).
Hostplant: *Sophora.*
Usinger described and figured the last nymphal instar (p. 149, pl. 12, B).

Genus NYSIUS Dallas, 1852:551

Usinger, 1942:84, detailed redescription.

This is a cosmopolitan genus which has a greater development in Hawaii than in any one other area. There are now 22 species, one subspecies and one variety recognized as Hawaiian. Here it shares with *Nesomartis* the comparatively conspicuous pubescence and erect setae which clothe the greater part of the dorsal surfaces. The breadth of the head across the eyes is, however, less than the breadth of the pronotum (it is greater on *Nesomartis*). The hind margins of the metapleura are concave with the postero-lateral angle rounded off. The elevated parts of the bucculae extend back to about half way between the anterior part of the antenniferous tubercles and the base of the head, whereas they do not extend much if any behind the fore edges of the antenniferous tubercles in *Oceanides, Glyptonysius* and *Neseis*.

Usinger (1942:119) says that in Hawaii "a wider range of characters is exhibited by these species [of *Nysius*] than in the combined *Nysius* fauna of the rest of the world. Such characters as form of bucculae, length of rostrum, and shape of costal margins, which are fairly reliable guides to genera elsewhere, break down completely in the various extreme species of Hawaiian *Nysius*."

Unlike the other genera of Hawaiian Orsillini, most of the members of this genus are not uni-insular in their distribution but are found on two to several islands; one species has been found on seven islands and probably occurs on more. For this reason I have not been able to make a second set of keys based primarily on geographical distribution.

Keys to the Hawaiian Nysius

Main island species....................................Section A
Leeward island species................................Section B

SECTION A--THE MAIN ISLAND FORMS

1. Rostrum distinctly surpassing posterior coxae, reaching apex of second abdominal segment or attaining fourth or sixth ventrite (except in female of *communis*, in which it may extend hardly beyond middle of second ventrite).. 2
   Rostrum shorter, not or scarcely passing posterior coxae, at most not passing middle of second ventrite............. 4

2(1). Head about as long as broad across eyes, rostrum reaching sixth abdominal segment; relatively small, 3.77 mm., with considerable ferruginous color above; Molokai....... ....**abnormis** Usinger.
   Head broader than long; rostrum shorter; color fulvous or testaceous above 3

3(2). Pale color largely fulvous; membrane distinctly fusco-fasciate along middle................. **communis** Usinger.
Pale color of pronotum and hemelytra either clear hyaline or testaceous; membrane immaculate or nearly so; Kauai .... **mixtus** Usinger.

4(1). Anteocular part of head very long, about half again as long as an eye or almost twice as long as an eye (measure carefully with eye-piece micrometer); corium clothed with short, appressed, pale pubescence imparting a grayish cast to the insect; without conspicuous erect hairs..... 5
Anteocular part of head much shorter, about as long as an eye or at most one-fourth longer; corium often with conspicuous erect hairs as well as subappressed hairs..... 7

5(4). Femora usually dark brown to pitchy black except at apices; pronotal disc with irregularly spaced punctures interspersed with irregular smooth areas posteriorly; Maui and Hawaii.................. **lichenicola** Kirkaldy.
Femora uniformly fulvous or distinctly brown-spotted; pronotal disc densely covered with small punctures...... 6

6(5). Eyes located posteriorly, very near level of posterior margin of head; pronotum subcylindrical, at least anteriorly; scutellum about as long as broad; claval suture bounded on either side by a row of distinct punctures and vein R of corium with a distinct row of punctures throughout its length, best seen in side view; costal margins strongly explanate; Oahu and Maui.......... **sublittoralis** Perkins.
Eyes located a little farther forward, posterior margin of head rounded laterally to eyes; pronotum subflattened or at least feebly, roundly carinate laterally on anterior lobe; claval suture and corial vein R impunctate or at least without conspicuous punctures and costal margins less strongly expanded; Kauai, Oahu, Maui, Hawaii, Nihoa .... **longicollis** Blackburn.

7(4). Rostrum reaching only middle coxae; species of intermediate size with immaculate or only faintly infuscated membrane; head black except for a narrow pale spot or line at middle of hind margin above and along tylus; scutellum black except at apex; clavus and corium with backwardly directed, inconspicuous, suberect hairs; all (?) main islands............... **nigriscutellatus** Usinger.
Rostrum reaching or passing posterior coxae............. 8

8(7). Costal margins strongly dilated, body form comparatively short and broad posteriorly; pronotum subcylindrical anteriorly and relatively strongly convex; femora either entirely pale fulvous or paler with only an occasional brown spot or entirely brown with irregular darker brown spots or markings........................... 9
Sides of body more nearly subparallel; femora yellowish or testaceous with distinct spots or markings (sometimes entirely black except at apices in *nemorivagus* and *blackburni,* both of which have a broad, subflattened pronotum) 10

9(8). Color above rufescent marked with black; pronotum only moderately convex; claval suture and corial vein R without visible punctures except near base; membrane almost entirely clear hyaline; femora pale fulvous or paler with only a few spots; Hawaii...............**rubescens** White.

Color dark brown above with black markings and pale mainly along expanded costal margins and at middle of membrane basally; pronotum very strongly convex; claval suture and corial vein R with rows of punctures which are only distinct under high magnification; membrane broadly dark brown on either side near middle of apices of coria and continuing posteriorly to apex; femora generally dark brown with still darker spots or markings visible; Oahu.................**fucatus** Usinger.

10(8). Fourth antennal segment very long, almost half again as long as third; small species (3 to 4 mm. long) with almost entirely black undersurfaces and appendages; upper surface variable, black to ferrugineous; Maui, Hawaii, Molokai (?)..................**blackburni** White.

Fourth antennal segment scarcely longer than third........11

11(10). Color in great part dark brown to black, with paler markings on head and pronotum; clavus and corium irregularly marked with paler spots; entire expanded costal area intruding to apical margin of corium at its junction with radial vein, pale; antennae black...............
.................................**nemorivagus** White.

Corium often marked with fuscous but with pale color always predominant; antennae at least partly paler......12

12(11). Length 3.5 to 4 mm.; form short and broad, costal margins abruptly dilated subbasally and roundly converging posteriorly; corial veins embrowned and membrane fuscomaculate ....**terrestris** Usinger.

Larger, over 4 mm. long..............................13

13(12). Color almost entirely pale above except for usual black on head and callosities, with only occasional or ill-defined markings on scutellum, clavus, corium and membrane
....................................**dallasi** White.

Scutellum black except at tip and at least with fuscous on commissure of clavus and inner veins of corium.........14

14(13). Hemelytra very pale, almost white, and characteristically marked; apical margin of corium entirely broadly black, or paler near inner and outer angles, and often with scattered fuscous marks posteriorly on vein R and on corial disc between R+M and Cu; vein Cu almost always immaculate; membrane clear................**delectus** White.

Hemelytra clear or with a faint fulvous tinge; apical margin of corium alternated with black and ochraceous, only black at joining of vein Cu, between arms of R+M, and subapically at joining of vein Sc; vein Cu irregularly spotted with fuscous; membrane with a more or less distinct fuscous median fascia on apical half..............15

15(14). Size about 4.27 to 5.72 mm. long; anteocular part of head scarcely longer than an eye; pale areas of clavus and corium testaceous or clear hyaline........**coenosulus** Stål.
Larger, 5.6 to 6.4 mm. in length; anteocular part of head almost one-fourth longer than an eye; pale areas of clavus and corium faintly tinged with fulvous; Hawaii ....**delectulus** Perkins.

SECTION B—THE LEEWARD ISLAND FORMS

1. Anteocular part of head two-thirds longer than an eye; body clothed above with a short, appressed, white pubescence imparting a grayish appearance; Nihoa......... ....**longicollis** Blackburn.
Anteocular part of head never more than one-third longer than an eye; pubescence, at least on clavus and corium, more erect and hence less conspicuous unless seen from side 2

2(1). Rostrum not or scarcely passing middle coxae............ 3
Rostrum reaching well onto posterior coxae.............. 7

3(2). Costal margins subparallel to about basal fifth and then abruptly, arcuately expanded; hemelytra somewhat abbreviated and distinctly, irregularly maculated with brown on clavus and corium and on membrane at least basally and at middle; upper surface of head and pronotum strongly, evenly, arcuately declivous as seen from side; fourth ventral segment of female concealed beneath third at middle.................................... 4
Costal margins appearing more evenly, feebly arcuate throughout, scarcely or only briefly subparallel basally; hemelytra of average length and fuscomaculate only interruptedly on apical margin of corium and occasionally on corial veins; membrane clear or scarcely infuscated; head and pronotum less strongly declivous above; fourth ventral segment in female often visible for a short distance at middle................................... 5

4(3). Small, dark species, 3.39 to 3.77 mm. in length; membrane broadly brown near apical margins of coria and generally embrowned with pale veins; Nihoa......**suffusus** Usinger.
Larger and paler, 3.58 to 4.11 mm. long; membrane only narrowly brown along apical margins of coria and infuscated along middle and apically; Necker............. ....**chenopodii** Usinger.

5(3). Size large, female 4.83 to 5.16 mm. long; dorsum of body with some long, erect hairs best seen from side; Nihoa ....**nihoae** Usinger.
Size smaller than indicated above; dorsum of body without conspicuous, long, erect hairs as seen from side......... 6

6(5). Head moderately, roundly convex above; body in great part pale; scutellum pale except on basal third; apical margins of coria with alternated black markings inconspicuous or wanting; Necker.........**neckerensis** Usinger.

Head only feebly elevated along middle; scutellum usually entirely black except at extreme apex; apical margins of coria each with three distinct fuscous spots; French Frigate Shoal..................**nigriscutellatus** Usinger.

7(2). Upper surface of body with relatively short and inconspicuous erect hairs as seen from side; costal margins subparallel basally and then abruptly, strongly arcuate; hemelytra abbreviated, often only slightly passing tip of abdomen in females; French Frigate Shoal...**frigatensis** Usinger.

Upper surface of body with numerous, very long, erect hairs among subappressed ones, as seen from side; costal margins of coria more or less sinuate............ 8

8(7). Very pale yellowish above, dark markings of head, pronotum, scutellum and apical margins of coria very limited in extent; posterior lobe of pronotum very sparsely punctate, punctures pale; Lisianski..**fullawayi flavus** Usinger.

Darker in coloration, with denser, black punctures on posterior lobe of pronotum; Pearl and Hermes Reef, Midway. 9

9(8). Body almost entirely brown above, yellowish at middle of head, at sides of posterior lobe of pronotum, on middle of scutellum apically, and irregularly paler elsewhere; Pearl and Hermes Reef......**fullawayi infuscatus** Usinger.

Much paler in coloration, being predominantly yellowish-ochraceous above with usual black markings and black punctures; Pearl and Hermes Reef, Midway...................................**fullawayi fullawayi** Usinger.

Nysius abnormis Usinger (fig. 31).

Nysius abnormis Usinger, 1942:112, pl. 9, D.

Endemic. Molokai (type locality: Kamiloloa, 3,000 to 3,500 feet).

Hostplant: *Styphelia tameiameiae.*

The rostrum reaches the sixth abdominal sternite and is thus longer than in any other Hawaiian member of the tribe. Only the holotype is known.

Nysius blackburni White (fig. 31).

Nysius blackburni White, 1881:53. Kirkaldy, 1908:190. Usinger, 1942:99, pl. 9, I, redescription.

Nysius lichenicola variety (*b*) *brunnealis* Kirkaldy, 1910:541.

Nysius lichenicola variety (*c*) *atralis* Kirkaldy, 1910:541.

Perkins (1912:733) synonymized *lichenicola* with this species, but Usinger found them to be distinct.

Endemic. Maui, Hawaii (type locality: Kilauea, 4,000 feet).

Hostplants: *Acacia koa, Dubautia,* ferns.

Perkins (1913:cxcv) found specimens of this species "feeding in little groups of several together on the droppings of mynah birds. These birds at the time were feeding on the fruit of an imported raspberry."

Nysius chenopodii Usinger (fig. 34).
Nysius chenopodii Usinger, 1942:97.

Endemic. Necker Island (type locality).
Hostplant: *Chenopodium.*
In my opinion, this form may not be specifically distinct from *suffusus.*

Nysius coenosulus Stål (figs. 31, 33).
Nysius coenosulus Stål, 1859:243. White, 1878:369. Kirkaldy, 1910:540. Usinger, 1942:106, pl. 8, D, redescription; 140–145, pl. 10 (life history), bionomics, detailed description of nymphal stages.

Endemic. Kauai, Oahu (type locality: Honolulu), Molokai, Lanai, Maui, Hawaii.
Hostplants: *Acacia koa, Amaranthus, Argyroxiphium grayanum, Clermontia, Dodonaea, Dubautia, Eragrostis leptophylla, Erigeron* (a preferred host), *Euphorbia, Erythrina, Geranium, Heterotheca, Lythrum, Metrosideros, Myoporum, Myrsine, Pelea, Sadleria, Scaevola, Sophora, Styphelia.*
This was the first Hawaiian orsilline bug to be described. It was collected in 1852 by the expedition of the "Eugenie."
Usinger found the eggs inserted deep in the green, opened flower heads of *Erigeron*—as many as 12 to a head. There may be eight or nine generations a year, for the life cycle requires about six weeks. See Usinger for detailed studies of the immature stages.

Nysius communis Usinger (fig. 31).
Nysius communis Usinger, 1942:110, pl. 8, A.

Endemic. Kauai, Oahu, Molokai, Lanai, Maui, Hawaii (type locality: Humuula).
Hostplants: *Argyroxiphium grayanum, A. sandwicensis, A. virescens, Artemisia, Bidens* (preferred host), *Cheirodendron, Cibotium menziesii, Coprosma, Euphorbia, Lobelia gloria-montis, Metrosideros, Sadleria, Scaevola, Sophora, Styphelia.*

Nysius dallasi White (fig. 31).
Nysius dallasi White, 1878:367. Kirkaldy, 1907:152 (as *vinitor*). Perkins, 1912:732. Usinger, 1942:105, pl. 8, F, redescription.

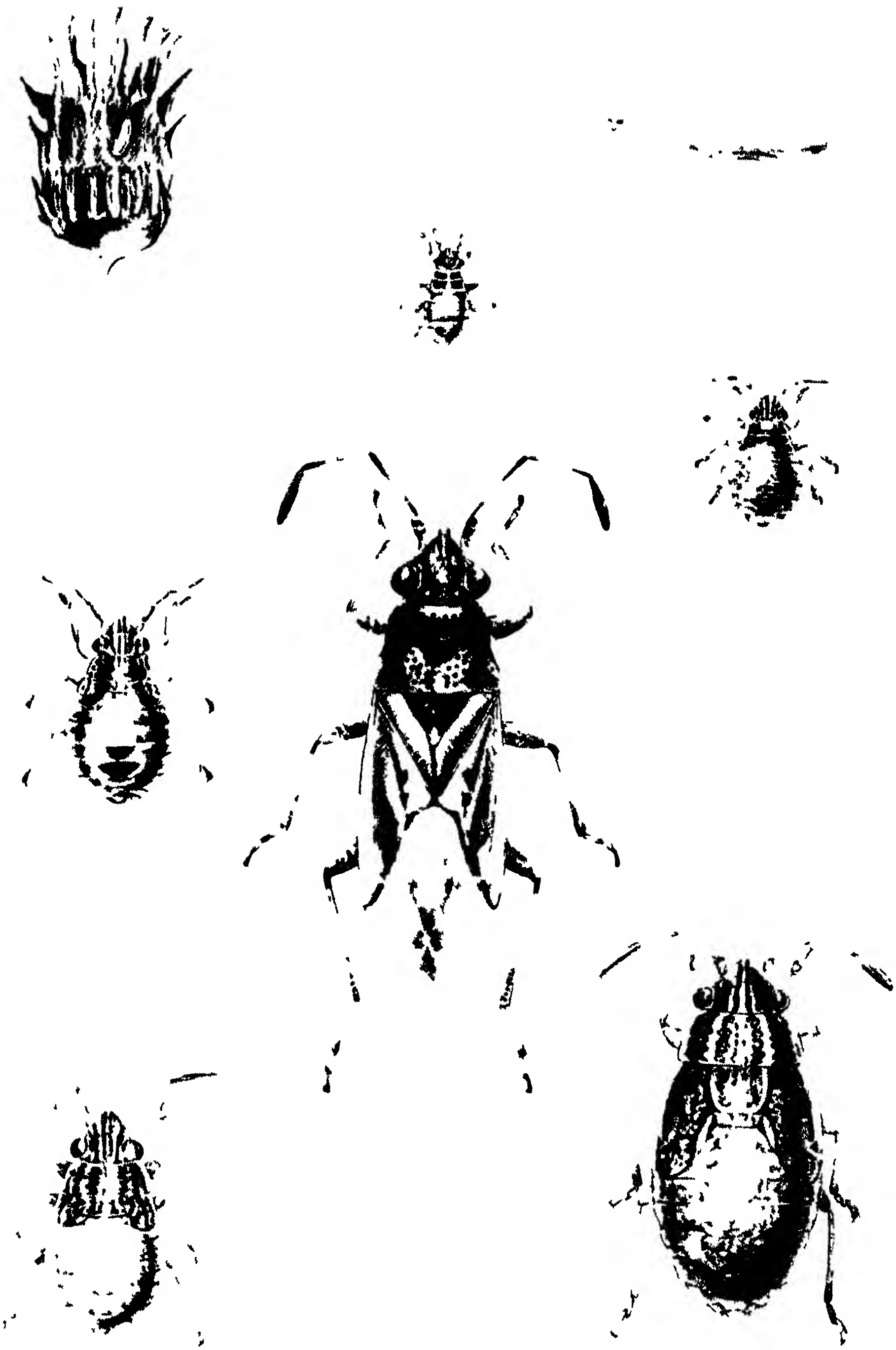


Figure 33—*Nysius coenosulus* Stål. Egg in place in flower head of *Erigeron canadensis*, egg (enlarged), the five nymphal instars and an adult male. (After Usinger.)

Endemic. Kauai, Oahu (type locality: Nuuanu Pali), Molokai, Hawaii.
Hostplant: *Portulaca.*
It has been taken at light.

Nysius delectulus Perkins (figs. 22, b; 35).
Nysius delectulus Perkins, 1912:736. Usinger, 1942:107, pl. 8, B, redescription.

Endemic. Hawaii (type locality: Kilauea).
Hostplant: *Dubautia scabra.*
Although Perkins says that this species occurs on all the islands from sea level to high elevations and definitely refers to specimens from Maui and Oahu, Usinger lists it from Hawaii only and does not discuss Perkins' records.

Nysius delectus White (fig. 35).
Nysius delectus White, 1878:367. Usinger, 1942:108, redescription, illustration (pl. 8, C) and guide to literature.
Nysius kamehameha Kirkaldy, 1902:164 (type locality: Hawaii, Hualalai, 5,000 feet); synonymy by Usinger, 1942:108.

Endemic. Oahu, Molokai, Lanai, Maui, Hawaii (No type locality given by White.)
Hostplants: *Coprosma, Dubautia, Metrosideros, Myrsine, Pelea, Phyllostegia, Stachytarpheta, Verbena bonariensis.*

Figure 34—*Nysius chenopodii* Usinger, paratype female, left; *Nysius neckerensis* Usinger, female, center; *Nysius frigatensis* Usinger, paratype male, right

Nysius frigatensis Usinger (fig. 34).
Nysius frigatensis Usinger, 1942:94.

Endemic. French Frigate Shoal (type locality).
This may belong to the *fullawayi* complex.

Nysius fucatus Usinger (fig. 35).
Nysius fucatus Usinger, 1942:90, pl. 9, K.

Endemic. Oahu (type locality: Kolekole Pass).
Hostplant: *Bidens.*

Nysius fullawayi fullawayi Usinger (fig. 35).
Nysius fullawayi fullawayi Usinger, 1942:93, pl. 9, E.

Endemic. Pearl and Hermes Reef (type locality), Midway (?).
The hemelytra on this form are nearly immaculate.

Nysius fullawayi infuscatus Usinger (fig. 35).
Nysius fullawayi fullawayi variety *infuscatus* Usinger, 1942:94, pl. 9, G.

Endemic. Pearl and Hermes Reef (type locality).
The hemelytra on this variety are maculate on both clavus and corium.

Nysius fullawayi flavus Usinger.
Nysius fullawayi subspecies *flavus* Usinger, 1942:94.

Endemic. Lisianski Island (type locality: northeast corner of the island).
Hostplant: bunch grass (?).
This subspecies is pale and flavescent instead of ochraceous.

Nysius lichenicola Kirkaldy (fig. 36).
Nysius lichenicola Kirkaldy, 1910:540. Usinger, 1942:98, redescription.

Endemic. Maui (type locality: Mount Haleakala, 7,000 feet), Hawaii.
Hostplants: *Acacia koa,* dandelion, *Dubautia, Eragrostis* (preferred host), *Geranium, Metrosideros, Sophora, Styphelia, Vaccinium.*

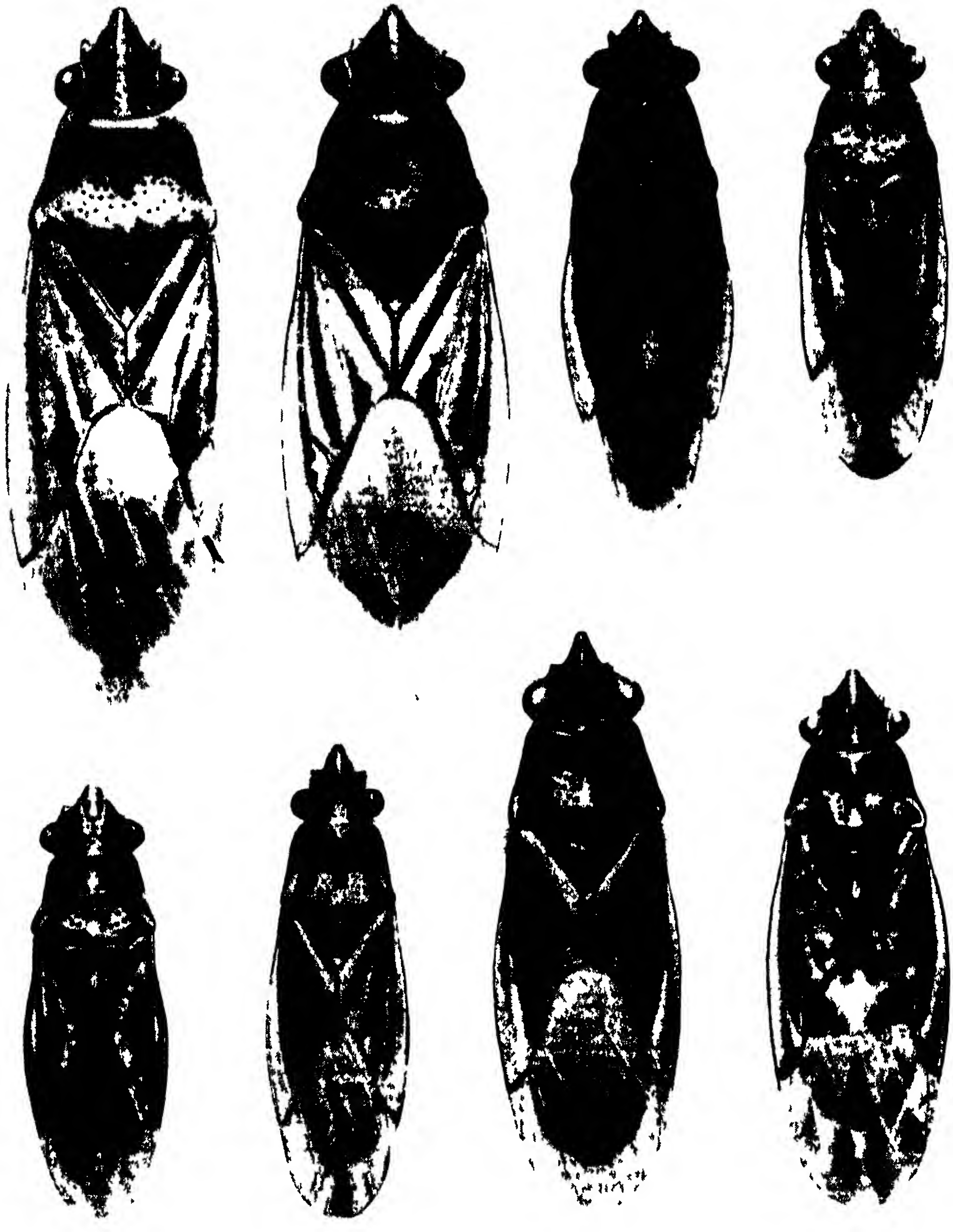


Figure 35—*Nysius* species. Top row, left to right: *N. delectulus* Perkins, allotype female; *N. delectus* White, female; *N. fucatus* Usinger, holotype male; *N. fullawayi fullawayi* Usinger, male. Bottom row, left to right: *N. fullawayi infuscatus* Usinger, holotype male; *N. longicollis* Blackburn, male; *N. mixtus* Usinger, female; *N. nemorivagus* White, female. (Rearranged from Usinger's original Abernathy drawings.)

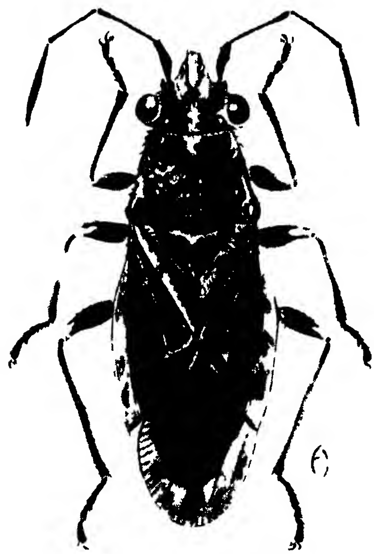


Figure 36—*Nysius lichenicola* Kirkaldy. (Abernathy drawing.)

Usinger (1942:99) stated that "The nearest extra-Hawaiian relative of *N. lichenicola* appears to be *N. huttoni* White from New Zealand. . . ." I do not believe that it has been shown that this species is a relative of the New Zealand species. It would be more appropriate to say that of the known extra-Hawaiian species, *N. lichenicola* resembles *N. huttoni* more than any other species.

Nysius longicollis Blackburn (fig. 35).

Nysius longicollis Blackburn, 1888:344. Perkins, 1912:733, redescription of the holotype. Usinger, 1942:89, pl. 9, C, redescription.

Endemic. Kauai, Oahu (no further type locality given by Blackburn), Maui, Hawaii, Nihoa.

Hostplant: *Eragrostis*.

Nysius mixtus Usinger (fig. 35).

Nysius mixtus Usinger, 1942:110, pl. 8, E.

Endemic. Kauai (type locality: Kalalau).

Hostplants: *Dubautia, Styphelia*.

Nysius neckerensis Usinger (fig. 34).

Nysius neckerensis Usinger, 1942:104.

Endemic. Necker Island (type locality).

Hostplant: *Chenopodium*.

Nysius nemorivagus White (fig. 35).

Nysius nemorivagus White, 1881:54. Perkins, 1912:734. Usinger, 1942:101, pl. 9, F, redescription.

Endemic. Kauai, Oahu (?), Molokai, Lanai, Maui, Hawaii (type series from Mauna Kea, Hawaii, and Haleakala, Maui, 5,000 to 6,000 feet).

Hostplants: amaranth, Chinese cabbage, *Clermontia,* cucumber, *Dubautia, Lythrum,* potato (reported to have caused severe withering), *Solanum nodiflorum, Sophora,* hard-skinned squash.

Nysius nigriscutellatus Usinger (fig. 37).

Nysius nigriscutellatus Usinger, 1942:102, pl. 8, G.

Endemic. Kauai, Oahu, Molokai, Lanai (?), Maui, Kahoolawe, Hawaii (type locality: Humuula, 6,000 feet), French Frigate Shoal.

Hostplants: amaranth, *Argyroxiphium grayanum, Artemisia, Cheirodendron gaudichaudi,* dandelion, *Dubautia, Eragrostis,* mango ("feeding on the fruits"), *Osmanthus, Portulaca, Sida,* spinach, *Styphelia.*

This is the most widespread of all of the endemic Hawaiian Heteroptera. It occurs from the beaches to over 10,000 feet in the mountains and is spread throughout most of the Hawaiian Archipelago.

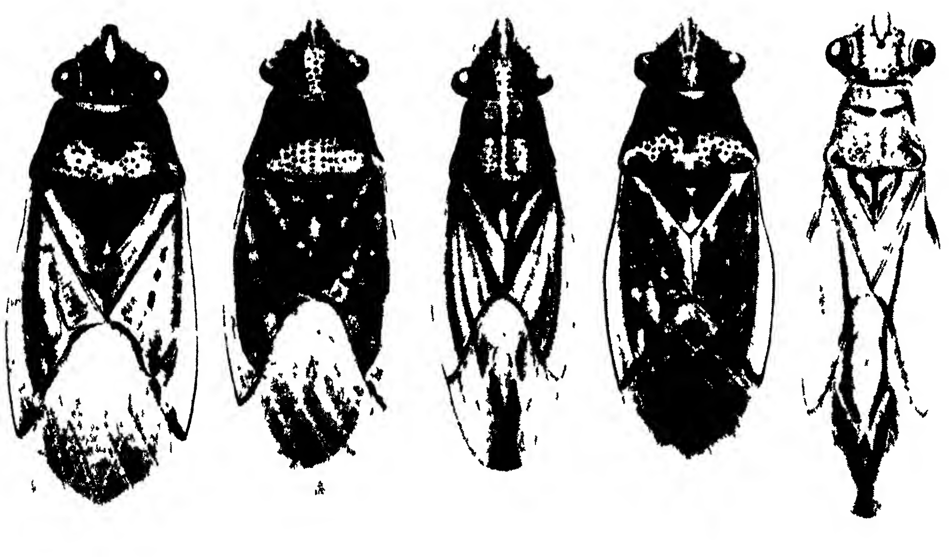


Figure 37—Species of Orsillini Left to right: *Nysius nigriscutellatus* Usinger, female; *Nysius rubescens* White, female; *Nysius sublittoralis* Perkins, male; *Nysius terrestris* Usinger, female; *Nesomartis psammophila* Kirkaldy, female. (Rearranged from Usinger's original Abernathy drawings.)

Nysius nihoae Usinger.
Nysius nihoae Usinger, 1942:103.

Endemic. Nihoa Island (type locality).
Is this form more than a geographical segregate of *nigriscutellatus?*

Nysius rubescens White (figs. 21, 37).
Nysius rubescens White, 1881:55. Perkins, 1912:732. Usinger, 1942:91, pl. 9, H, redescription.

Endemic. Hawaii (type locality: Kilauea, 4,000 feet).
Hostplants: *Vaccinium* ("ohelo" berry), ferns.
The last nymphal instar has been described and figured by Usinger, p. 152, pl. 12, F.

Nysius sublittoralis Perkins (fig. 37).
Nysius sublittoralis Perkins, 1912:737. Usinger, 1942:88, pl. 9, B, redescription.

Endemic. Oahu (type locality: Waianae coast), Maui, Hawaii.
Hostplant: *Nicotiana tabacum* (native hosts unknown).

Nysius suffusus Usinger.
Nysius suffusus Usinger, 1942:96.

Endemic. Nihoa Island (type locality).
Hostplant: "bunch grass."

Nysius terrestris Usinger (fig. 37).
Nysius terrestris Usinger, 1942:95, pl. 9, J.

Endemic. Kauai, Oahu (type locality: Manana Islet), Molokai, Maui, Kahoolawe, Hawaii.
Hostplants: *Argyroxiphium*, Chinese cabbage. *Dubautia, Geranium, Hibiscus, Portulaca* (preferred host), *Sida, Sophora, Styphelia.*
The following observations are Usinger's (1942:152):

This species occurs in great numbers in company with *Nysius dallasi* on *Portulaca oleracea.* I found the two species in great abundance in the dense growth of *Portulaca* which completely carpets large areas of ground on Manana Island [Oahu]. Thirty-seven copulating pairs were counted, and no crossing of the two species was observed.

Near the beach at Mapulehu, Molokai, a similar situation was observed, thousands of bugs running about on the plants and on the ground beneath. Nymphs from the first instar (pink or red in color) to large last instar crowded and tumbled about in the dry dirt.... On August 17, 1936, several perfectly typical *Nysius* eggs were found glued to the surface of the glass vial with dirt particles adhering to them, forming a protecting or concealing cover. These eggs hatched on August 23, giving an incubation period of six days.

This species was accidentally introduced to Johnston Island during the war.

Genus NESOMARTIS Kirkaldy, 1907:245

Kirkaldy, 1910:535.
Usinger, 1942:113, redescription.

This endemic genus is represented by one of the most distinct members of our Orsillini. Kirkaldy originally placed it in the subfamily Cyminae. Its long, slender, hairy body, its relatively narrow pronotum and correspondingly broad head, whose greatest breadth across the eyes is greater than the base of the pronotum, will serve to distinguish it easily from all the other Hawaiian members of the tribe. The elevated parts of the bucculae extend well behind the fore edges of the antenniferous tubercles, and the hind margins of the metapleura are concave. A single species is known.

Nesomartis psammophila Kirkaldy (fig. 37).
Nesomartis psammophila Kirkaldy, 1907:245. Usinger, 1942:113, pl. 9, A, redescription. Genotype.

Endemic. Kauai, Oahu (type locality: not stated more definitely by Kirkaldy), Maui, Hawaii.

Hostplants: *Eragrostis* (bunch grass, preferred host), *Sida, Sophora.*

"*Nesomartis psammophila* frequents sandy places, on or near the coast, living on low grass, or on the ground beneath, with its nymphs. In the larger of these the head is not produced far beyond the sides of the pronotum, as in the adult, but is of ordinary form. The youngest nymphs are remarkable for their shining black head and thorax, with white mediodorsal line." (Perkins, 1913:cxcv.)

Tribe METRARGINI (Kirkaldy) Usinger, 1942:15

Metrarginae Kirkaldy, 1902:164.
Hutchinson, 1934:134, brief note.

This group is endemic to the Hawaiian Islands. It is closely related to, if truly separable from, the Orsillini, and it evidently is an offshoot of some old Hawaiian *Nysius*-like bug. Usinger (1942:16) says that "*Metrarga* is structurally very

similar to the Orsillini but is very different in appearance, being much broader and flatter, the antenniferous tubercles sharply produced as stout spines, the posterior margin of sixth tergite in the male subtruncate, the coxal flanges punctate, and corial vein Sc distinct throughout its length and evidently complete, joining apical margin of corium near corial apex." The less divergent species might appear to be only generically distinct from *Nysius,* and the relationship is obvious.

The three divergent groups of species thus far discovered were given subgeneric rank by Kirkaldy in 1908, after he had considered them species in 1902. Usinger tells me that they are entitled to generic standing. I have followed his decision, although I feel that I might not consider them any more than distinct species of a single genus, but I am not a specialist in the Heteroptera.

The winged species are often notably gregarious, a dozen to scores congregating together at the base of the leaves of a single plant of *Freycinetia.* The nymphs occur in the same situation, sometimes mixed with the adults. These winged species may also be found on the ground amongst dead leaves or fragments of fern fronds, while the flightless *M. villosa* seems to have taken entirely to a terrestrial life, and perhaps became flightless in accordance with these habits. It is remarkable that amongst large flocks of one of the winged species (e.g. *contracta*) one or two examples of another species (*nuda*) are sometimes found, so that the flocks are mixed. The odour of the species is disgusting, when a colony is disturbed, and taints the surrounding air. While the representatives of *M. nuda* that are found on Hawaii, Oahu, and Maui are very similar, it is noteworthy that the Molokai form, although of precisely similar habits, is more distinct in appearance superficially. (Perkins, 1913:cxciv.)

Perkins (1913:cxcv) notes that certain species of *Nysius* (*sensu lato* ?) "... are at times met with living gregariously at the base of the leaves of *Freycinetia* like the *Metrargae.*"

I have never met with any species of the group in such numbers as Perkins describes, nor have I seen any long series of specimens collected since Perkins' time. There appears to be no doubt that these insects have become much rarer in the last quarter of a century.

Key to the Genera of Metrargini

1. Pronotum with each antero-lateral angle produced as a prominent, acutely pointed tooth (fig. 38) .... **Metrarga** White.
   Antero-lateral pronotal angles rounded (fig. 39, middle and right) 2
2. Membrane of hemelytra not reduced, much longer than length of claval suture; ocelli well developed (fig. 39, right) .... **Nesoclimacias** (Kirkaldy).
   Membrane of hemelytra greatly reduced, much shorter than claval suture; ocelli usually obsolete (fig. 39, middle) .... **Nesocryptias** (Kirkaldy).

Genus METRARGA White, 1878:370

This group has the wing membrane normal, not abbreviated, and the fore corners of the pronotum are each produced into a sharp spine. There are several new forms awaiting description.

Key to the Forms of Metrarga

1. Distance across head to outer edges of eyes slightly greater than distance between apices of antero-lateral pronotal spines... ....**obscura** Blackburn.
   Distance between apices of antero-lateral pronotal spines greater than breadth of head to outer edges of eyes................. 2
2. Explanate corial margins distinctly and conspicuously spotted ....**nuda nuda** White.
   Explanate corial margins obscurely and indistinctly maculate ....**nuda mauiensis** Kirkaldy.

Figure 38—*Metrarga obscura* Blackburn.

Metrarga nuda nuda White (fig. 39).
Metrarga nuda White, 1878:371. Kirkaldy, 1902:165, pl. 5, figs. 41–42. Genotype.

Endemic. Oahu, Maui, Hawaii. (No type locality given by White.)

Kirkaldy (1907:153) described the nymph as follows: "Antennal tubercles acute and prominent; eyes not touching pronotum. Pronotum about 3 times as wide as long, the lateral margins laminate and minutely crenulate. Abdomen laterally explanate, odoriferous orifices elongate and very short, on fifth and sixth tergites."

Habit: found under dead bark and in cavities in dead branches of *Pipturus, Metrosideros* and *Cibotium.*

Metrarga nuda mauiensis Kirkaldy.
Metrarga nuda variety *mauiensis* Kirkaldy, 1908:188.

Endemic. Maui (type locality not specifically given).

Metrarga obscura Blackburn (fig. 38).
Metrarga obscura Blackburn, 1888:347.

Endemic. Hawaii (type locality: Mauna Loa, 4,000 feet).
Hostplant: *Metrosideros.*

Genus NESOCLIMACIAS (Kirkaldy)

Subgenus *Nesoclimacias* Kirkaldy, 1908:189.

This group resembles *Nesocryptias,* but the hemelytra are fully formed, and the hind wings are developed for flight. The antero-lateral corners of the pronotum are rounded. In the genotype, *contracta,* the first segment of the rostrum reaches the front edge of the fore coxae. However, in *lanaiensis* it is shorter, and this character can hardly be used in a supraspecific sense as Kirkaldy used it in 1908.

A new species from Molokai is in our collections.

Key to the Forms of Nesoclimacias

1. Rostrum not extending beyond middle of fourth abdominal ventrite; Lanai .... **lanaiensis** (Kirkaldy).
   Rostrum reaching middle of fourth ventrite or beyond........ 2
2. Pronotum and hemelytra mostly yellowish-brown............ ....**contracta contracta** (Blackburn).
   Pronotum and hemelytra mostly dark brown to piceous...... .... **contracta picea** (Kirkaldy).

Nesoclimacias contracta contracta (Blackburn) (fig. 39).
Metrarga contracta Blackburn, 1888:347.
Metrarga (*Nesoclimacias*) *contracta* (Blackburn) Kirkaldy, 1908:189. Genotype of *Nesoclimacias.*

Endemic. Oahu (type locality: Konahuanui, 2,500 feet).
Habit: it has been found in decaying vegetation and at the leaf bases of *Freycinetia.*

Nesoclimacias contracta picea Kirkaldy.

Nesoclimacias contracta variety *picea* Kirkaldy, 1908:188.

Endemic Oahu (type locality: Koolau Mountains).

Habit: Kirkaldy (1908:188) reported finding it in ground litter and on *Freycinetia.*

Nesoclimacias lanaiensis (Kirkaldy).

Metrarga (*Nesoclimacias*) *lanaiensis* Kirkaldy, 1908:189; 1902:166–167, in part, pl. 5, fig. 43 a.

Endemic Lanai (no definite type locality given, but taken at 2,000 feet or at Halepaakai)

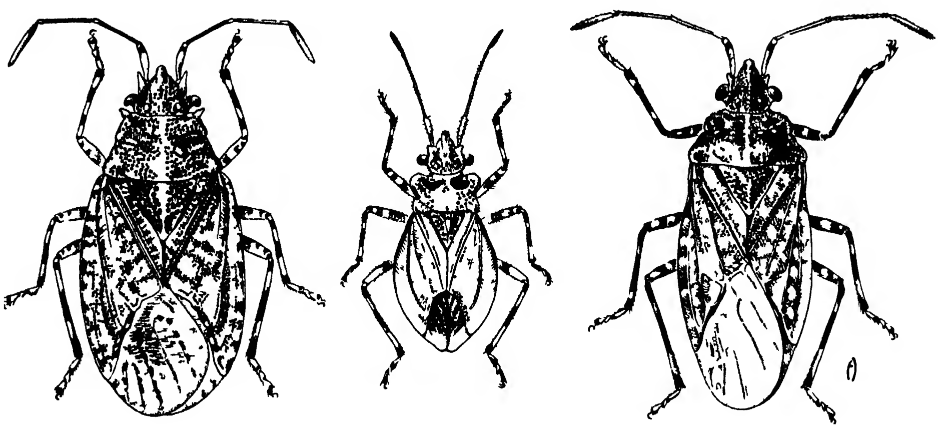


Figure 39—*Metrarga nuda nuda* White, left *Nesocryptias villosa* (White), middle *Nesoclimacias contracta* (Blackburn), right (Drawn to same scale by Abernathy)

Genus NESOCRYPTIAS (Kirkaldy)

Subgenus *Nesocryptias* Kirkaldy, 1908·189.

The species assigned to this genus are essentially brachypterous, flightless derivatives of *Nesoclimacias* The hemelytra have the membrane greatly reduced so that it reaches only slightly behind the apices of the coria—its extreme length is less than the length of a clavus, whereas it is much longer than a clavus in *Nesoclimacias.* The hind wings are greatly reduced to squamiform appendages shorter

than the scutellum. The antero-lateral corners of the pronotum are rounded, and, on the specimens examined, the rostrum passes the metacoxae. Most of the specimens examined by me have their ocelli obsolete.

A new Oahu species has been seen.

Nesocryptias villosa (White) (fig. 39).

Metrarga villosa White, 1878:371. Kirkaldy, 1902:167, pl. 5, fig. 44.

Metrarga (*Nesocryptias*) *villosa* (White) Kirkaldy, 1908:189.

Endemic. Kauai, Oahu (type locality: "Not rare among rotten leaves, etc., at the foot of a precipice on the mountains five or six miles from Honolulu.").

Hostplants: *Byronia, Freycinetia, Myoporum,* and found among decaying vegetation and damp ground litter in the forests.

Subfamily GEOCORINAE (Stål) Distant, 1882

Geocorida Stål, 1862.

The Big-eyed Bugs

These bugs are easy to distinguish from the other Hawaiian Heteroptera because of their large, unusual eyes (see fig. 40). They somewhat resemble certain Orsillini, but a glance at their heads will distinguish them. The salient characters are well expressed by the illustrations.

This subfamily is not represented in the native fauna of Hawaii, but the high islands to the south and southwest have endemic species. The genus *Germalus* is well represented as far east as the Marquesas Islands, where it has developed several distinct species. Had that genus reached Hawaii at an early date, it is probable that it might have proliferated as did the *Nysius* group. *Germalus,* because of its habits and facies, recalls *Nysius* to me whenever I collect it in the south Pacific.

Genus **GEOCORIS** Fallen, 1814

Usinger, 1936:213, redescription.

The two species found in Hawaii are adventitious.

"Almost without exception the early references condemn the bugs as destructive, often simply on superficial evidence of their occurrence on a given plant. All recent records throughout the world, however, report them as predaceous on eggs,

nymphs, or even adults of mites, aphids, plant bugs, leafhoppers, etc." (Usinger, 1936:214.) York (1944:25) has reported on his studies of the habits of our two species in California. He found that they fed upon the beet leafhopper (*Eutettix tenellus* [Baker]) and its eggs. The *Geocoris* cannot live upon insects or plants alone, for, although they feed upon eggs, nymphs and adults of the leafhopper, they need extra water which can only be supplied from the plants. York (1944) concluded "that it would be practicable to experiment with these predators as a factor of natural control." He also summarized previous work as follows:

Chamberlin and Tenhet (1923) reported *Geocoris punctipes* (Say) as feeding on flea beetles. Gilmore (1936) observed the same species feeding on eggs of the tobacco horn-worm. Knowlton (1937) fed *Geocoris decoratus* (Uhler) on beet leafhoppers, and showed them to be capable of reducing leafhopper populations. Ewing and McGarr (unpublished report 1931) and King and Cook (1932), however, reported that *Geocoris punctipes* (Say) fed on cotton plants in cage experiments and produced positive reactions internally but no external swellings or damage. Lockwood (1933) has reported *Geocoris* spp. and other plant bugs as destructive to cotton in California.

Perhaps these latter reports confused the moisture-getting habit with destructive feeding.

Key to the Geocoris Found in Hawaii

1. Head and pronotum distinctly hirsute; head minutely granulate, predominantly black, without an oblique sulcus arising from near base of tylus............................**pallens** Stål.
2. Head and pronotum appearing bare; head smooth and polished, shiny, predominantly yellow marked with black, with a distinct sulcus arising from near base of tylus and directed obliquely outward and forward toward inner interior edges of each eye..............................**punctipes** (Say).

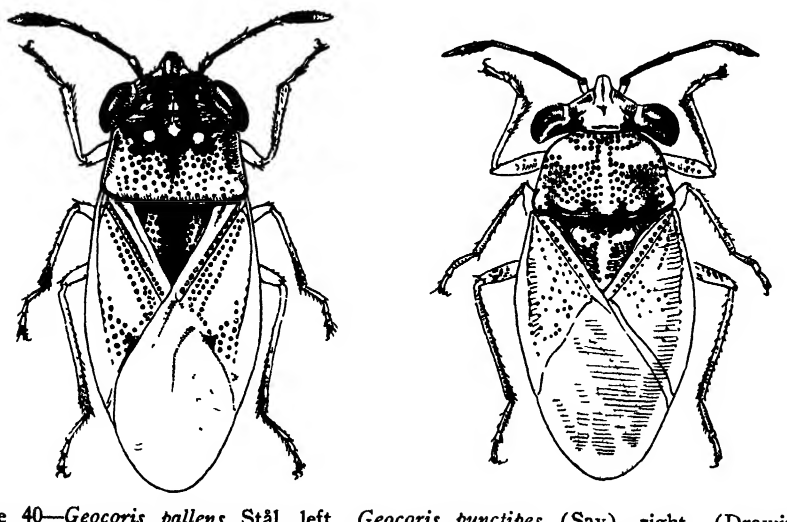


Figure 40—*Geocoris pallens* Stål, left. *Geocoris punctipes* (Say), right. (Drawings by Abernathy; *G. pallens* drawn to one-fifth larger scale than *G. punctipes*.)

Geocoris pallens Stål (fig. 40).
Geocoris pallens Stål, 1874:236.

Kauai, Oahu, Hawaii.

Immigrant. A common species in western United States. First reported in the Hawaiian Islands by Usinger (1936:214) from specimens collected in 1935.

Hostplants: bunch grass, *Ipomoea, Sophora, Sporobolus, Vitex.*

This species is smaller than *punctipes,* "head black, finely granular and beset with a short, sparse, white pubescence. Longitudinal and transverse sulci, except on tylus, obscure or wanting. Antero-lateral margins of pronotum distinctly angulated. Head, in great part, pronotum anteriorly and extending posteriorly behind the callosities, and scutellum at base and longitudinally at middle, black. Hemelytra opaque. Length, 3.5 mm." (Usinger, 1936:214.)

Geocoris punctipes (Say) (fig. 40).
Saïda bullata variety *punctipes* Say, 1832:19.

Kauai, Oahu, Molokai.

Immigrant. Widespread in southwestern United States and Mexico. First found in the Hawaiian Islands by Swezey in 1935 at Ewa Coral Plain, Oahu.

Hostplants: Australian salt bush, *Cynodon dactylon* (Bermuda grass), *Ilex sandwicensis, Portulaca.*

The nymphs are greenish-gray or whitish with black markings.

"A large, polished species rather uniformly light in color. Head in great part ochraceous or with fuscous to black markings, not at all granulous, with a fine longitudinal sulcus extending from sulcation of tylus onto vertex. A distinct, transverse arcuate sulcus behind the tylus, not attaining eyes. Antero-lateral angles of pronotum rounded. Basal angles of scutellum with distinct, pale calloused areas. Hemelytra hyaline. Length 4–4.5 mm." (Usinger, 1936:213.)

Subfamily CYMINAE (Stål) Uhler, 1877

Cymida Stål, 1862.

The members of this subfamily are perhaps most readily distinguished from the other Hawaiian Lygaeidae because they have the clavi and coria conspicuously and extensively punctate, but the eyes are not enlarged as in the Geocorinae, and they have a different abdominal structure from the Rhyparochrominae, some of which have punctate hemelytra.

The genus *Nesocymus* from the Marquesas may be related to the Hawaiian generic complex.

Key to the Genera of Hawaiian Cyminae

1. Rostrum reaching, or extending only a short distance behind, fore coxae .... **Pseudocymus** Van Duzee.
   Rostrum extending distinctly behind fore coxae, nearly to or to mesocoxae 2
2. Distance between ocelli approximately equal to distance between an ocellus and an eye; pronotum with a distinct, entire, narrow, transverse, dorsal impression at about middle.. **Nesocymus** Kirkaldy.
   Distance between ocelli obviously greater than distance between an ocellus and an eye; pronotum without such an impression .... **Sephora** Kirkaldy.

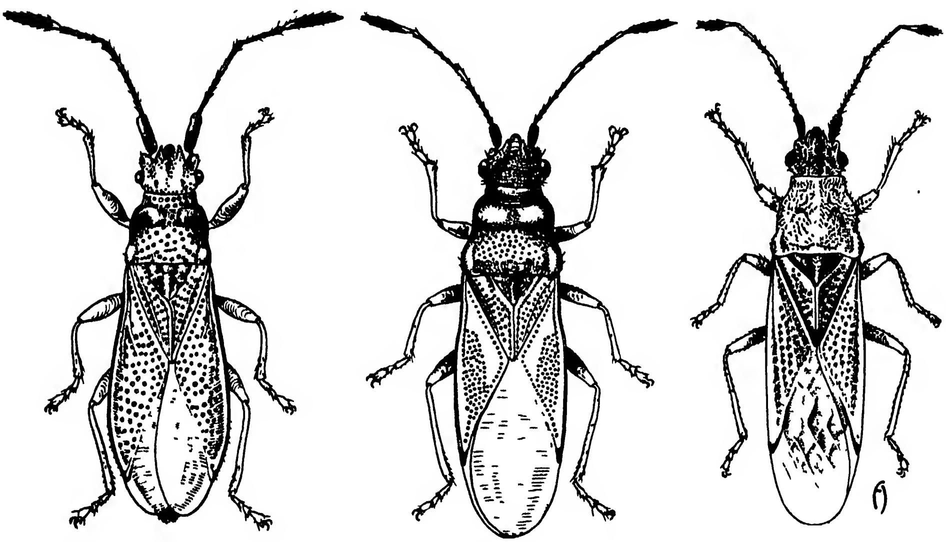


Figure 41—*Pseudocymus giffardi* Van Duzee, left. *Nesocymus calvus* (White), middle. *Sephora criniger* (White), right. (All drawn to same scale by Abernathy.)

Genus **PSEUDOCYMUS** Van Duzee, 1936:223

This monotypic, endemic genus is obviously allied to the other two Hawaiian genera of Cyminae. Its short rostrum, veinless, transparent hemelytral membrane and comparatively bare, shiny dorsum are some of the characters which may serve to distinguish it.

Pseudocymus giffardi Van Duzee (fig. 41).
Pseudocymus giffardi Van Duzee, 1936:224. Genotype.

Endemic. Oahu (type locality: Nuuanu Pali).
Hostplant: *Eragrostis.*

Genus **NESOCYMUS** Kirkaldy, 1907:245

In addition to the differential characters mentioned in the key, the only described species of this endemic genus may be distinguished by its striking color pattern. The wing membrane bears a conspicuous, broad, median, dark vitta; the anterior lobe of the pronotum is grayish-velutinous or pruinose, and this pale color extends back on the sides and at the middle to form a zigzag pattern along the anterior part of the brown, posterior, pronotal lobe. Some of the membranal veins are faintly indicated.

I have seen a series of a distinct new species from the island of Hawaii.

Nesocymus calvus (White) (fig. 41).

Cymus calvus White, 1881:56.

Sephora calvus (White) Kirkaldy, 1902:162.

Nesocymus calvus (White) Kirkaldy, 1907:245. Genotype.

Endemic. Oahu (type locality: "Under stones in the mountains near Honolulu, at an elevation of about 2000 feet.").

Hostplants: sedges, *Carex, Cyperus, Eragrostis, Pipturus.*

Dr. Swezey took a series of this species from a native sedge in the mountains above Kahana, Oahu. The specimens were on the flower clusters. The last two hostplants mentioned above probably are not hosts, for the bug is a sedge-eating species. Perkins (1913:cxciv) noted that it "lives on sedges, nymphs and adults occurring together, often in great numbers."

Genus **SEPHORA** Kirkaldy, 1902:161

There is only one species described in this endemic genus. The veins in the hemelytra are distinct and the setae on the entire dorsum are longer and obviously more conspicuous than on the representatives of the other two associated genera. The genotype is a yellowish insect with a grayish cast.

Sephora criniger (White) (fig. 41).

Cymus criniger White, 1881:57.

Sephora criniger (White) Kirkaldy, 1902:161, pl. 5, fig. 45. Genotype.

Endemic. Molokai, Lanai, Maui (type locality: Mount Haleakala, 5,000 feet, under stones).

Hostplants: *Coprosma, Gouldia, Sadleria, Scaevola, Straussia,* fern fronds.

Subfamily RHYPAROCHROMINAE (Stål) Van Duzee, 1917

Rhyparochromida Stål, 1862.

The best diagnostic feature of this subfamily is the shape and course of the hind margin of the third abdominal ventrite as mentioned in the key to the subfamilies. The hind margin may be somewhat obscure laterad, but it does not extend directly to the side margin and it usually curves distinctly cephalad. Although not all the species found in Hawaii have spined femora, the only Hawaiian representatives of the family with armed femora do belong here (*Pachybrachius* and *Tempyra*).

This is the largest subfamily of the Lygaeidae, yet it has no endemic representatives in our insular fauna.

Key to the Genera of Rhyparochrominae Found in Hawaii

1. Fore femora with conspicuous stout spines beneath......... 2
   Fore femora without spines............................ 3

2(1). Pronotum with a strongly developed, conspicuous collar, lateral margins not margined; ocelli conspicuous..**Pachybrachius** Hahn.
   Pronotum without a collar, lateral margins distinctly margined, narrowly explanate; ocelli obsolete.....**Tempyra** Stål.

3(1). Underside of head conspicuously grooved almost to prothorax, the conspicuously elevated sides of groove extending nearly to base; prosternum distinctly grooved in middle in front of coxae for reception of rostrum which does not reach fore coxae......................**Reclada** White.
   Rostral groove not extending much behind fore edges of eyes; prosternum not longitudinally grooved; rostrum reaching beyond fore coxae.............**Clerada** Signoret.

Genus PACHYBRACHIUS Hahn, 1826

Orthaea Dallas, 1852. See China, 1943.
Orthoea, of some authors.

The armed fore femora will separate this genus from the other Hawaiian members of the subfamily, excepting *Tempyra,* but that genus is distinct from *Pachybrachius* because it lacks a well-developed pronotal collar, it does not have the pronotum strongly and sharply divided into two large lobes, its pronotum is explanate on the sides instead of being rounded off and not margined—in addition to numerous other differences.

Both species of the genus are attracted to light, often in great numbers, especially on calm, damp nights.

Although this is a large and difficult group, the two species found in Hawaii are distinct and easily recognized.

Key to the Species of Pachybrachius Found in Hawaii

1. Pronotum, scutellum, corium and clavus with long, fine, conspicuous erect hair........................**nigriceps** (Dallas).
2. Pronotum, scutellum, corium and clavus not at all "hairy," with short, appressed, sparse, inconspicuous setae..**vincta** (Say).

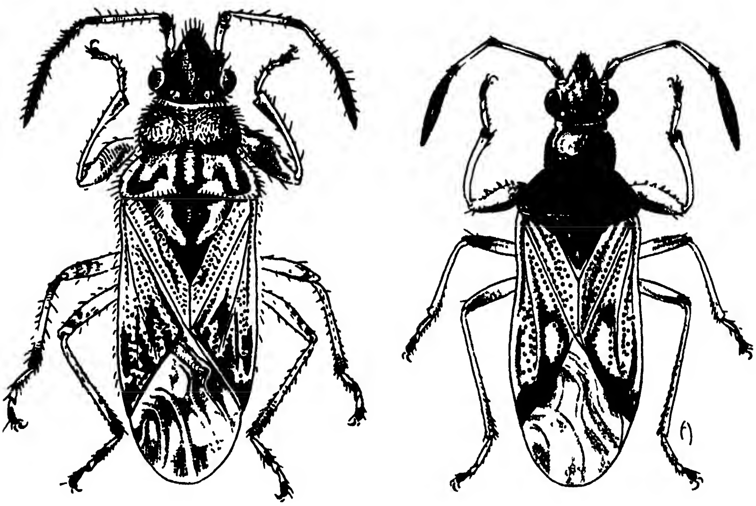


Figure 42—*Pachybrachius nigriceps* (Dallas), left. *Pachybrachius vincta* (Say), right. (Drawings by Abernathy. *P. vincta* drawn to one-sixth larger scale.)

Pachybrachius nigriceps (Dallas) (fig. 42).

Rhyparochromus nigriceps Dallas, 1852:577.

Pamera nigriceps (Dallas) Stål, 1874:152. White, 1878:369.

Orthaea nigriceps (Dallas), of authors.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii (type locality: "Sandwich Islands").

Immigrant. Widespread in the Pacific, but described from our islands.

Hostplants: *Coprosma, Gouldia,* grasses, *Lythrum, Sophora.*

This species may occasionally occur in numbers on truck crops, especially during dry weather when its lowland hostplants dry up. It has been reported "damaging" certain crops and has been confused with *Nysius* by some local workers.

Myers (1926:482–483) describes the early stages and gives notes on the insect in New Zealand.

Pachybrachius vincta (Say) (fig. 42).
Pamera vincta Say, 1832:16.
Orthaea pacifica Kirkaldy, 1907:150, not Stål.
Orthaea periplanios Kirkaldy, 1907:246.
Orthaea vincta (Say), of authors.

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. Almost tropicopolitan; probably a western Pacific species. First found in the Hawaiian Islands at Waikiki, Oahu, in 1900 (although Kirkaldy, 1907:150, says it was 1902 or 1903).

Hostplants: *Clermontia, Cynodon dactylon* (preferred host ?), *Sophora, Vaccinium* ("ohelo").

The brachypterous individuals look like a different species. They are narrower and have the wing membrane so reduced that the genital capsule and adjacent abdominal tergites are exposed. Kirkaldy (1907:150–151) described the last nymphal instar in detail.

Genus **TEMPYRA** Stål, 1874

Epelytes Kirkaldy, 1910:119.

Among the Hawaiian members of the subfamily, this genus has the sides of the pronotum explanate in common with *Clerada* and *Reclada,* but it is easily distinguished from those genera because of its multispinose fore femora alone, not to mention the many other differences.

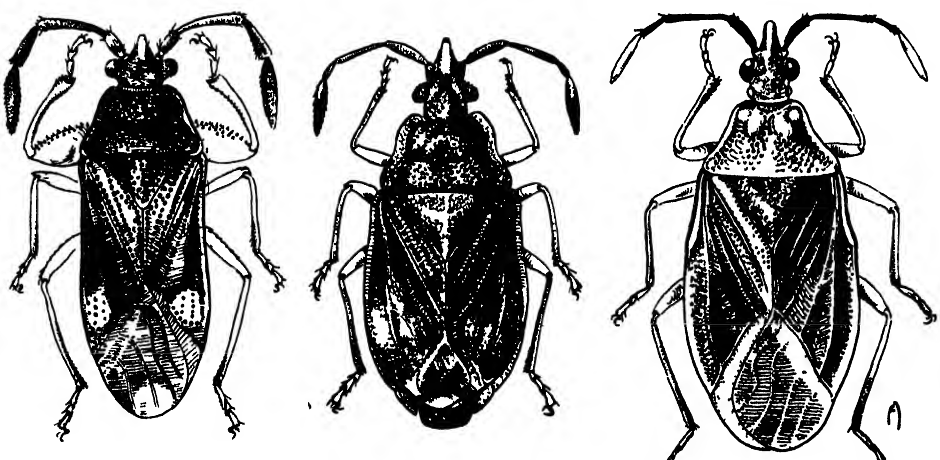


Figure 43—*Tempyra biguttula* Stål, left; *Reclada moesta* White, middle (drawn to same scale); *Clerada apicicornis* Signoret, right, drawn to twelve-sevenths the scale of the other two drawings. (Drawn by Abernathy.)

Tempyra biguttula Stål (fig. 43).
Tempyra biguttula Stål, 1874:157. Genotype.
Epelytes draptes Kirkaldy, 1910:119. (Genotype of *Epelytes;* described from Koloa, Kauai.)

Kauai, Oahu.

Immigrant. Known also from North America; originally described from Texas. Found by Swezey on Kauai in 1908, and a specimen in Perkins' collection bears a label reading "a late introduction, Honolulu, 1908."

Hostplant: *Canavalia.*

It is attracted to light, and most of the specimens seen were taken at light. The type of *draptes,* which is in the collection of the Experiment Station, Hawaiian Sugar Planters' Association, was found in a bean pod. The pale spot on each corium is distinctive; see the illustration. Nothing appears to be known of its habits. Is it predaceous?

Genus **RECLADA** White, 1878:370

This genus is allied to *Clerada* and shares with it the remarkably situated ocelli. These organs are placed on the sides of the upper surface of the head on or slightly behind a line drawn between the hind margins of the eyes. The hemelytral membrane does not exceed, or hardly exceeds, the tip of the abdomen, and the entire insect is dull and punctate.

Reclada moesta White (fig. 43).
Reclada moesta White, 1878:370. Genotype.
Clerada minuta China, 1924:435, fig. 1, C. Synonymy by China, 1930:127.

Kauai, Oahu (exact type locality not known), Nihoa.

Immigrant. Probably widespread, but little known, from the Mascarene subregion to Polynesia.

Hostplants: bunch grass, *Euphorbia, Pritchardia.*

It may be predaceous.

Genus **CLERADA** Signoret, 1863:J–28

This genus is allied to *Reclada* but can be distinguished by not having the underside of its head and prosternum grooved as in *Reclada* and by having its rostrum extending beyond the fore coxae. Our species is about twice as large as the representative of *Reclada* (about 7 or 8 mm. as compared to about 3 or 4 mm.).

The hemelytral membrane reaches hardly beyond the abdomen.

Clerada apicicornis Signoret (fig. 43).
Clerada apicicornis Signoret, 1863:J–28, pl. 20, fig. 8.

Kauai, Oahu, Hawaii.

Immigrant. Tropicopolitan. First recorded from the Hawaiian Islands by White, 1878:370.

This species has been found in a number of situations such as in *Pritchardia* palms in the mountains, in boxes, drawers, piles of wood, in clothes closets and about buildings. Kirkaldy (1907:151) suspected that it fed on silverfish and small cockroaches. Illingworth noted that Perkins found it feeding on a dead roach and reported that "These insects, in all stages, are often very common in the piles of dry wood in the shops of the College. I have never found them numerous in the house, but from time to time we find individuals. Upon two occasions we have taken them in the beds; and just recently, I caught an adult, full of blood, upon one of the sleeping children. The place bitten was red and resembled a flea-bite." (1917:274.) Illingworth's observations are of interest, for species of the genus have been found elsewhere in the nests of rodents and certain small mammals and have been reported to attack man. This bug needs detailed investigation. (See Herman Lent "Sobre o hematofagismo *Clerada apicicornis* e otros artropodos; sua importancia na transmissão da doença de Chagas." *Mem. Inst. Oswaldo Cruz,* 34:583–606, 1939.)

Kirkaldy (1907:151) gave a detailed description of the last nymphal instar. The terminal antennal segment on both the adult and nymph is conspicuously pale as compared to the remainder of the antennae.

Clerada apicicornis is a semi-domestic species, living and breeding freely in dirty houses and cupboards, where cockroaches are allowed to multiply. It also occurs in outhouses frequented by bed-bugs. On the other hand it can adapt itself to diverse conditions, and I have noticed adults and nymphs in numbers in dry sandy localities, living with various common cockroaches, especially *Periplaneta, Euthyrrhapha,* etc., beneath dead leaves. Curiously enough in the mountains it frequents the bases of the leaves of *Freycinetia,* like *Metrarga,* and was once found by me in company with these. (Perkins, 1913:cxciv.)

It has been collected at light.

Family TINGIDAE (Laporte, 1832) Westwood, 1840

Tingididae Fieber, 1860.
Tingitidae Stål, 1873.

Lace Bugs, Tingids

Most of the tingids are beautifully reticulated or bizarre in appearance, but they are represented in our fauna by only a single purposely introduced species. The head, pronotum and hemelytra are uniquely and coarsely sculptured in a con-

spicuously reticulated, lace-like pattern, the head is usually spinose, and the pronotum is often bulbous, and carinate or keeled, and it covers the scutellum. The antennae and rostra are four-segmented and the ocelli are wanting. There is no distinct clavus and the hemelytral membrane is entirely coarsely reticulated with the true veins obsolete. The tarsi are two-segmented and lack arolia. Our species cannot be confused with any other family represented in the archipelago.

See Opinion 143 of the International Rules of Zoological Nomenclature for spelling of the family name.

Subfamily TINGINAE (Amyot and Serville)

Tribe PHYSATOCHEILINI Blatchley, 1926:482

Genus **TELEONEMIA** Costa, 1864

This American genus contains many species.

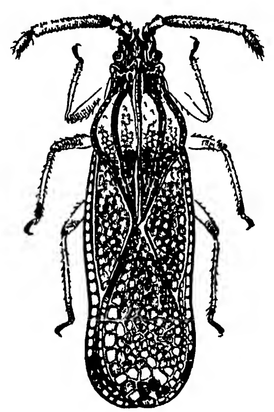


Figure 44—*Teleonemia scrupulosa* Stål The lantana lace bug. (Drawn by Abernathy.)

Teleonemia scrupulosa Stål (figs. 44, 45).

Teleonemia scrupulosa Stål, 1873:132.

Teleonemia bifasciata Champion, of Kirkaldy, 1905:216, misidentification.

Teleonemia lantanae Distant, 1907:60.

Teleonemia vanduzeei Drake, 1919:24.

Drake and Frick, 1939:199–202, fig. 1, discussion and synonymy (some of their references are muddled). Kirkaldy, 1907:154, describes the last nymphal instar.

The lantana lace bug.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii.

Introduced from Mexico by Koebele in 1902.

Hostplant: *Lantana.*

This common, widespread, slow-moving bug was purposely brought into Hawaii to aid in the control of *Lantana.* Sweetman (1936:360) said, "The great credit of inaugurating work on the biological control of noxious weeds belongs to the entomologists attached to the Hawaiian Sugar Planters' Association"—by virtue of the introduction of this bug. It has also been purposely introduced to Fiji and Australia.

Figure 45—Leaves of *Lantana* showing damage caused by the feeding of the lantana lace bug, *Teleonemia scrupulosa* Stål.

This Tingid bug occurs generally throughout the Hawaiian Islands, wherever there is lantana, more especially in the dry regions. It is elongate oval, about one-eighth inch in length, of a greyish brown color. They feed on the foliage.... They also feed to some extent on the flowers, injuring them to such extent as to prevent fruit setting.

When feeding on the leaves the usual result is that the leaves are so injured as to be useless to the plant, and they dry up and fall to the ground. In the usual attack the bushes are soon defoliated and look dead, but it is only temporary. If weather conditions are favorable for it, another growth is put forth, to be again attacked, with the result that often the plant is prevented from flowering, and in this way this bug operates against seed production by lantana. By its continuous successive attacks in some of the drier regions, the bushes have become so much crippled that in connection with the dry climate they have finally died out entirely.

The eggs are laid in the peduncle and probably in the veins of the under side of the lantana leaves. They are laid at right angles to the surface, the apex and egg cap protruding. An egg is a little more than half a millimeter in length, cylindrical, swollen in the middle, white. It is not known how many eggs one bug will lay, nor how long it takes the eggs to hatch; but they are apparently prolific, for as many as 250 young bugs have been counted feeding on the underside of a single leaf, and all leaves of the same bush well supplied.

The young bugs are blackish, obscure, dirty looking creatures which get their growth in about two to three weeks, then by a final molt assuming the winged or adult form. This bug has not been known to breed on any other plant than lantana, though the adult bugs have been found resting on many other kinds of plants in the vicinity of lantana, or even at a distance, but this is only casual, and never in such numbers as to be injurious. (Swezey, 1924:75–76.)

Family **ENICOCEPHALIDAE** Stål, 1860

Henicocephalidae, of various authors.

Gnat Bugs, Unique-headed Bugs

This family is an associate of the Reduviidae, and, in fact, it has been placed in that group by some workers. Its peculiar head and pronotum, however, serve to distinguish it. Antennae and rostrum four-segmented; head constricted behind eyes and near base, the postocular part globose and with two ocelli situated behind eyes; pronotum with two transverse constrictions, therefore composed of three lobes; hemelytra entirely membranous, with large cells, veins and cross-veins comparatively few; fore legs with single-segmented tarsi, mid and hind tarsi three-segmented, arolia absent.

The above combination of characters makes the enicocephalids one of the most distinct and easily recognized of all of the Hawaiian Heteroptera. Although the family is world-wide in distribution, it is poorly known, and fewer than 100 species have been described.

Subfamily ENICOCEPHALINAE Ashmead, 1893

Genus **NESENICOCEPHALUS** Usinger, 1939:268

This genus was erected to receive two peculiar members of the family (one from Hawaii, the other from the Philippine Islands) which differ from all other known genera in having the discal cell closed and the basal discal cell wanting.

The present known distribution of the group is certainly not the natural one, and additional species, and probably allied new genera, will be discovered as more collecting is done in the tropical Pacific.

Nesenicocephalus hawaiiensis Usinger (fig. 46).
Nesenicocephalus hawaiiensis Usinger, 1939:268, fig. 1. Genotype.

Endemic. Maui (type locality: ridge above Haelaau, West Maui, 3,000 to 3,300 feet).

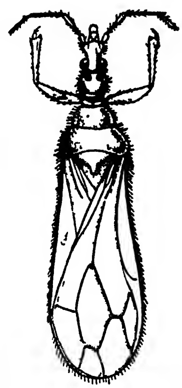


Figure 46—*Nesenicocephalus hawaiiensis* Usinger. (Cut loaned by Usinger.)

This small (2.32 mm.), fragile, gnat-like bug is known only from the unique type collected in 1928. It is strange that no other specimens of the family have been collected since. From the known habits of other members of the family, we would expect that this species, which is predaceous like its congeners, might be collected from dead vegetation or found in forest ground litter or under loose, dead bark. Also, it might be taken while swarming when it could be confused with chironomids or other flies in their nuptial flights. Some species have been collected at light.

Family **REDUVIIDAE** (Latreille, 1807) Stephens, 1829

Reduviids, Assassin Bugs, Kissing Bugs

The members of this large, widespread family are predaceous. Some species suck the blood of mammals and act as intermediate hosts of disease organisms, some of which are pathogenic to man. Only one subfamily, the Ploiariinae (Emesinae), has native species in the islands, although immigrant representatives of two other subfamilies have become established.

The following combination of characters will serve to characterize the family in Hawaii: rostrum three-segmented, curved (except in *Triatoma*) and not lying close against the under surface of the head; antennae four- or five-segmented; ocelli present or absent, when present situated behind the eyes; hemelytra, when present, complete and normal in our forms, clavus and corium present; tarsi one- to three-segmented, claws without arolia.

For a review of the higher classification of the reduviid series of families, see Usinger's "Revised Classification" (1943:602).

Key to the Subfamilies of Reduviidae Found in Hawaii

1. Ocelli absent; fore coxae greatly elongated, longer than head .... **Ploiariinae.**
   Ocelli present; fore coxae not elongated, much shorter than head. 2
2. First antennal segment shorter than head; head longer in front of eyes than behind eyes, and not constricted across dorsum in front of ocelli in our species.................. **Triatominae.**
   First antennal segment much longer than head; head shorter in front of eyes than behind eyes and deeply constricted dorsally in front of ocelli in our species........... **Harpactorinae.**

Subfamily PLOIARIINAE (Dohrn, 1863)

Emesinae, of various authors (*Ploiaria* Scopoli, 1786; *Emesa* Fabricius, 1803).

The Thread-legged Bugs

This group, which has good differential characters, is considered by some authors to be entitled to a family status. The lack of ocelli, the long fore coxae, the long, slender, delicate body, greatly elongated, thread-like antennae and legs amply serve to distinguish the subfamily.

Usinger (1943:605) notes that "The Emesinae have elongate, spindle-like eggs with numerous longitudinal folds."

Key to the Genera of Ploiariinae Found in Hawaii

1. Fore tarsi fully one-half as long as tibiae, with single claws only; fore trochanters with one or two large, conspicuous spines .... **Luteva** Dohrn.
   Fore tarsi only one-fourth or less as long as length of a tibia. claws paired; fore trochanters setose or hairy but not spinose.. 2
2. Fore femur without a differentiated basal spine... **Empicoris** Wolff.
   Fore femur with a large, stout, differentiated spine at base .... **Nesidiolestes** Kirkaldy.

Genus LUTEVA Dohrn, 1860

In our fauna, the members of this genus most closely resemble those of *Empicoris,* but they are easily distinguished by their shorter tarsi. They are predaceous upon small insects such as psocids. They frequent plant foliage.

Key to the Species of Luteva Found in Hawaii

1. Hind legs without a white band at apex of tibiae and base of femora; penultimate antennal segment about twice as long as terminal segment; anterior trochanters each with a single spine .... **insolida** White.

2'. Hind legs with apices of tibiae and bases of femora white and obviously paler than remainder of legs; penultimate and terminal antennal segments about equal in length; anterior trochanters each with a pair of spines.........**insulicola** Kirkaldy.

Luteva insolida White (fig. 47).

Luteva insolida White, 1877:113.

Ploiaria collenetti Cheesman, 1927:95. Synonymy by China, 1930:145, fig. 24, with detailed redescription.

Oahu, Lanai, Hawaii. (No type locality designated by White.)

Immigrant. Known also from Samoa and the Marquesas Islands.

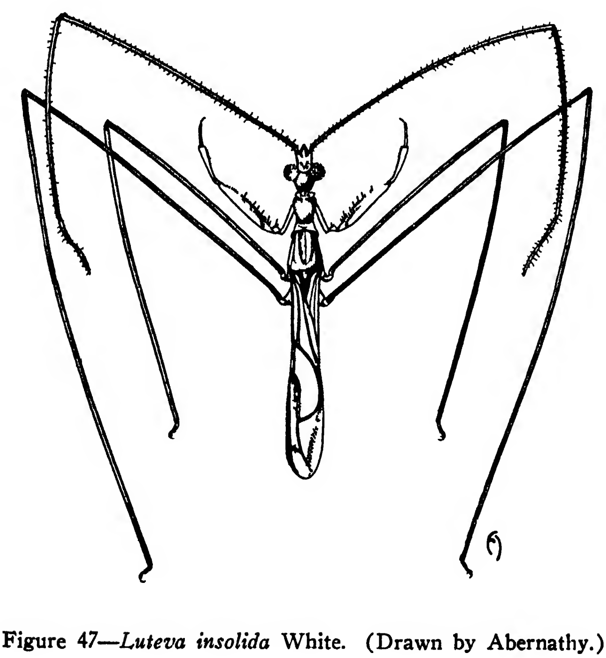


Figure 47—*Luteva insolida* White. (Drawn by Abernathy.)

Luteva insulicola Kirkaldy.

Luteva insulicola Kirkaldy, 1908:196.

Oahu (type locality: Waialua).

Immigrant (?).

Genus **EMPICORIS** Wolff, 1811

Ploiariodes White, 1881:58.

Genotype, *Cimex vagabundus* Linnaeus, the only species included by Wolff.

In addition to the differential characters mentioned under *Luteva* and in the key, our members of this genus may be distinguished from *Luteva* because the head and pronotum are dull and/or pilose and the pronotum is much shorter than the mesonotum. *Luteva* has a bare and more shiny dorsum, and its pronotum is about as long as the head or the mesonotum. The habits of the genus are similar to those of *Luteva;* they feed on psocids and other small insects and have been reported from spider webs. (See summary by Usinger, *Bull. Brooklyn Ent. Soc.* 36:206–208, 1941.)

I have not seen authentic specimens of *Empicoris pulchrus* and have been unable to separate it from the other species in the key. Kirkaldy (1902:151) separated *pulchrus* from *rubromaculatus* because he considered that the former did not have a reddish spot on the costal hemelytral margin. However, the red coloration is variable and may be present or absent in *rubromaculatus.*

Key to the Species of Empicoris Found in Hawaii

Excepting *E. pulchrus* (Blackburn).

1. Pronotum with a conspicuous keel-like tubercle at base of median line .... **whitei** (Blackburn).
   Pronotum without a keel at base of median line 2
2. Length 3.6–3.8 mm.; hind femora half again as thick near base as at middle; distance between arms of male genitalia about three-fourths as great as depth of emargination .... **minutus** Usinger.
   Length 5.0–5.5 mm.; hind femora only feebly thickened; distance across apices of arms of male genitalia greater than depth of emargination .... **rubromaculatus** (Blackburn).

Empicoris minutus Usinger.
Empicoris minutus Usinger, 1946:45.

Oahu.
Immigrant. Known also from Guam. First recorded from Hawaii by Usinger, 1946:46.
This species is closely allied to *rubromaculatus.*

Empicoris pulchrus (Blackburn).
Ploiariodes pulchra Blackburn, 1889:350.

Oahu (type locality: Konahuanui, about 2,000 feet).
Immigrant (?).

This species is unknown to me, and from the description it appears to be different from any of the other members of the subfamily in our collections.

Empicoris rubromaculatus (Blackburn) (fig. 48).

Ploiariodes rubromaculatus Blackburn, 1889:349.

See China, 1930:148, for synonymy.

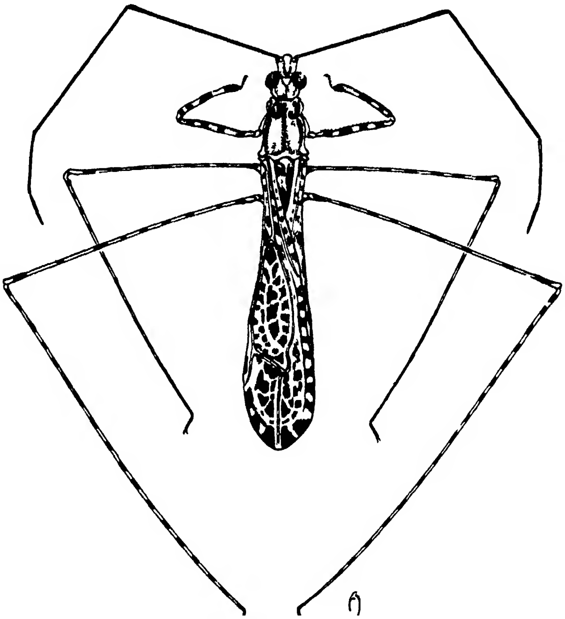


Figure 48—*Empicoris rubromaculatus* (Blackburn). (Abernathy drawing.)

The thread bug.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii (type locality: Mauna Loa, 4,000 feet), Midway.

Immigrant. North, Central and South America, Australia, New Zealand, Oceania.

Hostplants: *Clermontia,* ferns, *Ficus bengalensis, Maba sandwicensis, Metrosideros, Pritchardia.*

This is the commonest species of the genus in Hawaii as well as in America.

Empicoris whitei (Blackburn) (fig. 49).
Ploiariodes whitei Blackburn, in White, 1881:59. Genotype of *Ploiariodes.*

Oahu, Molokai, Lanai, Maui, Hawaii (type locality: Mauna Loa, 4,500 feet). Immigrant (?).
Hostplants: *Calpidia,* dead branches.

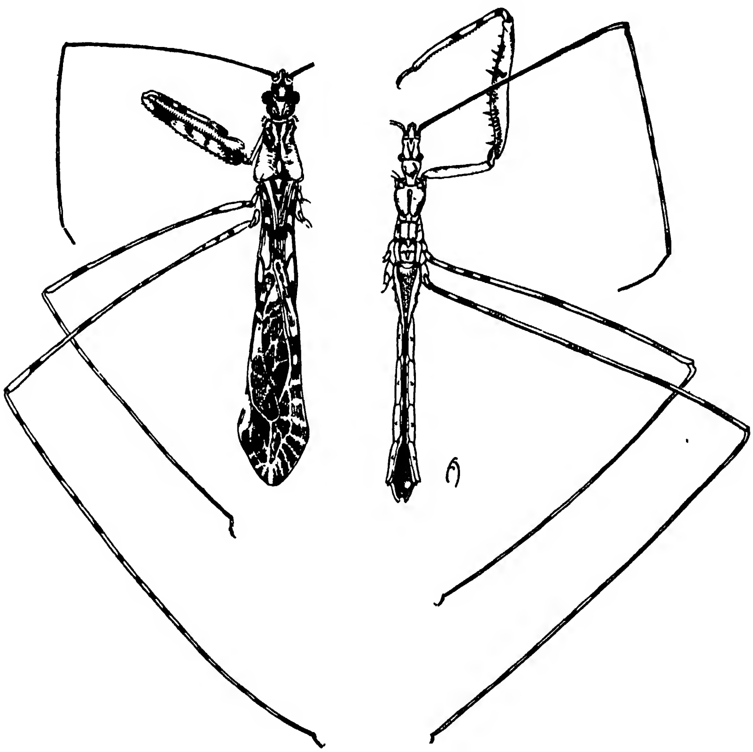


Figure 49—*Empicoris whitei* (Blackburn), left; *Nesidiolestes selium* Kirkaldy, right, drawn to one-half the scale of *Empicoris.* (Abernathy drawings.)

Genus **NESIDIOLESTES** Kirkaldy, 1902:152

This is an endemic genus which somewhat resembles South Pacific *Gardena.* All specimens collected have been apterous.

Nesidiolestes selium Kirkaldy (fig. 49).
Nesidiolestes selium Kirkaldy, 1902:153.
Nesidiolestes insularis Kirkaldy, 1908:195. New synonym.

Endemic. Kauai, Oahu, Hawaii (type locality: Olaa).

This large species frequents dead branches, foliage, ferns and clumps of grass. There has been confusion regarding it ever since Kirkaldy described *insularis* (the type, from Mount Tantalus, 1,800 feet, Oahu, is in the collection of the Hawaiian Sugar Planters' Association Experiment Station, and I have examined it). Kirkaldy described *insularis* while in Honolulu, and he stated: "This differs so much from my description of *N. selium,* that I fear there is some mistake therein." Mr. China has kindly examined the unique male type of *selium,* which is in the British Museum, and states that it bears the specific name label *"olana,"* a manuscript name not published by Kirkaldy. As noted elsewhere, such a bad habit was all too common with Kirkaldy. Mr. China says, "I have compared it (the type) with Kirkaldy's miserable description of *N. insularis* and find that it agrees tolerably well." And "Under the circumstances I think you would be justified in sinking *N. insularis* Kirk. as a synonym of *N. selium* Kirk." We may expect to find the species on Molokai and Maui, and I am rather surprised that a series of allied forms has not been found.

Subfamily TRIATOMINAE (Jeannel)

Triatomini Jeannel, 1919.
Triatomidae Pinto, 1926.

The Triatomas

"Unfortunately, the family name Triatomidae has found extensive use in parasitological literature but there is absolutely no foundation for such a status, no characters were given by Pinto to separate it from such Reduviinae as *Physoderes*, and hemipterists have not generally accepted the name. To accept the family Triatomidae would require the elevation of twenty-three other subfamilies to family rank." (Usinger, 1943:608.)

Genus **TRIATOMA** Laporte, 1832

The single immigrant representative of this genus cannot be confused with any other Hawaiian bug. Its large size (about three-fourths of an inch long when adult) will separate it from all others. Its rostrum, instead of being strongly curved and held far from the lower side of the head as in our other Reduviidae, is nearly straight and is folded close to the head at repose. The eggs are laid free and are of simple form.

We are fortunate in not having more than one species of this genus in Hawaii, because several of its members are vectors of South American trypanosomiasis.

Usinger (1944) has written an excellent account of the species of North and Central America.

Triatoma rubrofasciata (Degeer) (fig. 50).
Cimex rubro-fasciatus Degeer, 1773:349, pl. 35, fig. 12.
Usinger, 1944:64, pl. 9a, redescription.

The bloodsucking cone nose, "kissing" bug.
Oahu.

Immigrant. First recorded from the Hawaiian Islands by Kirkaldy, who considered it to be a native South American species. "It has not previously been recorded from these Islands though known to the Entomologists for three or four years" (1904:185). Usinger (1939:46; 1944:65), however, has pointed out that although now it has tropicopolitan distribution, it is an Old World species, probably Indian.

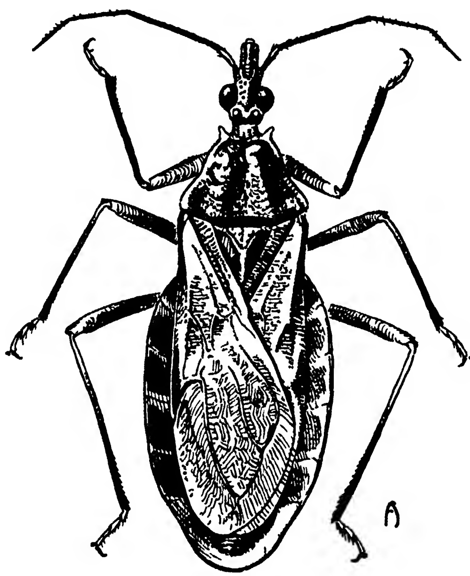


Figure 50—*Triatoma rubrofasciata* (Degeer). (Abernathy drawing.)

Hosts: sucks the blood of dogs, cats, pigeons, man, and probably rodents, other mammals and perhaps chickens and other birds. Little information regarding the hosts has been assembled in Hawaii. Illingworth (*Proc. Hawaiian Ent. Soc.* 9(3):374, 1937) reported finding it "breeding in hundreds in an old lumber pile.... This predaceous bug feeds on insects. In turning over the lumber one was found with its beak inserted in a dead American cockroach. One has to use care in handling them, for if given an opportunity they quickly sink their beaks into one's skin." I have failed to confirm Illingworth's observation as to their feeding on cockroaches. My captive specimens refused to feed on either dead or living cockroaches or other insects given them, and I do not believe that they are normally predaceous on other insects.

This species is known to be a vector of Chagas' disease (South American trypanosomiasis), which is caused by *Trypanosoma cruzi* Chagas, in Central and South America. In the Orient and Hawaii it is known to harbor another trypanosome, *Trypanosoma* (*Crithidia*) *conorhini* Donovan, which is not known to be pathogenic to man and whose vertebrate host is unknown, although it has been grown successfully in mice following artificial inoculation. For an extensive, detailed, abundantly illustrated account containing a lengthy bibliography of *T. conorhini*, see Morishita, 1935. For notes on the trypanosome in Hawaii, see Wood, 1946.

Figure 51—*Trypanosoma cruzi* Chagas with red blood corpuscles from an experimentally infected albino rat. (After Kofoid and Donat (1933); figure loaned by Fae Donat Wood)

Trypanosoma cruzi has not been found in Hawaii, but there is danger of its being introduced. Because of this potential danger, I believe it desirable to place certain pertinent excerpts from Usinger's valuable 1944 paper on file here. The following data are quoted from pages 3 and 4:

In the insect the entire life cycle of the trypanosome occupies from 6 to 15 days and is passed within the lumen of the alimentary tract, only rarely reaching the malpighian tubules. The blood trypanosomes transform into crithidia in the stomach These multiply posteriorly in the mid gut. In the hind gut the crithidia (non-infective) become smaller and give rise to metacyclic (infestive) trypanosomes. These are discharged with the excreta in varying numbers up to 3500 per cmm. No trace of trypanosomes is found in the salivary glands or in the body cavity. Transmission in humans occurs by rubbing the feces (which are excreted during or soon after feeding) into the wound or into skin abrasions by scratching, and by rubbing the feces into the conjunctiva of the eyes or into the mucous membranes of the mouth. Animals may become infected in the same manner as human beings and also by eating the bugs.

In vertebrates the trypanosomes are found in the peripheral blood for about two weeks. Fresh cover-slip preparations at this stage have been found to contain five or more trypanosomes in a thick drop of blood. Later these disappear from the peripheral blood and are found in the muscles of the heart and in other tissues. The incubation period in man is said to be 10 to 12 days.

A typical pathologic picture includes degeneration of invaded cells, cellular infiltration, and eventually fibrosis of the affected tissues. In acute cases all parts of the body are affected but most of the lesions are confined to the heart, brain, and liver. Congenital infection has been recorded by Mazza and Mayer (Strong, 1942).

"The most apparent symptoms," according to Dr. Mazotti, *in litt.*, "are fever and swelling of the eyelid and face (sign of Romana) usually accompanied with conjunctivitis and commonly unilateral."

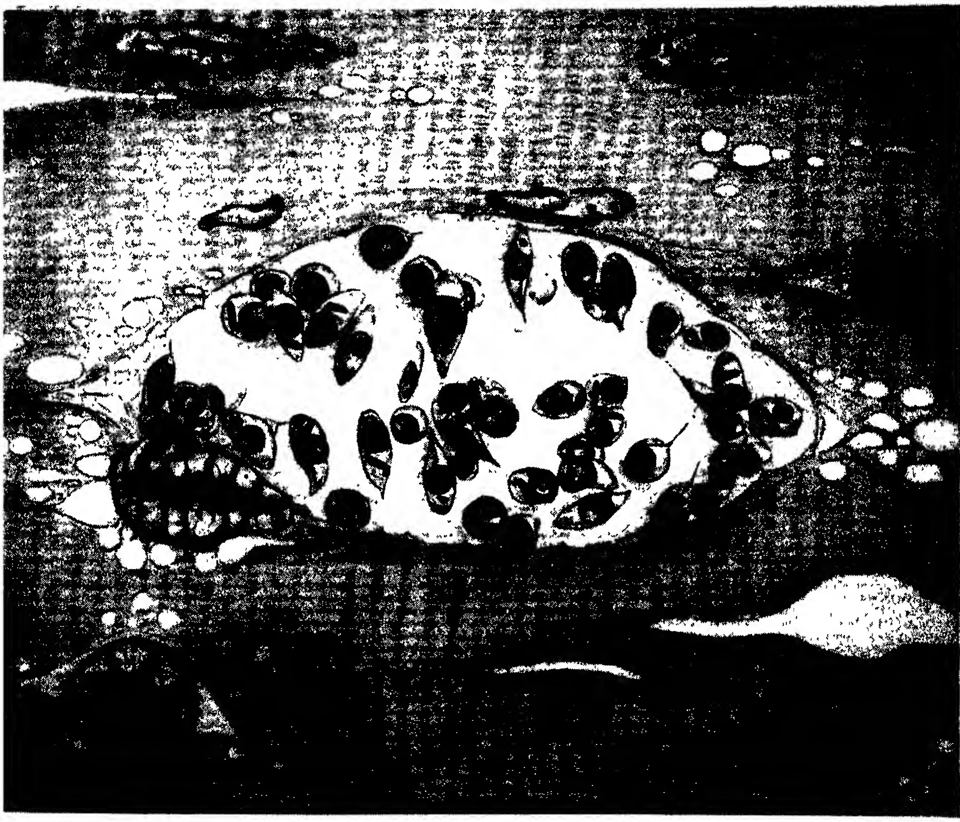


Figure 52—Developmental stages of *Trypanosoma cruzi* Chagas in heart muscle of albino rat. (After Kofoid and Donat (1933); figure loaned by Fae Donat Wood.)

Diagnosis is by inoculation of large volumes (5 cc. to 10 cc.) of blood into experimental animals and recovery of the trypanosomes in their peripheral blood. Here the dilution factor is so great that Brumpt (1914) developed a more sensitive technique called "xenodiagnosis" in which non-infected bugs are allowed to feed upon an infected animal. After multiplication in the alimentary tract of the bug, the trypanosomes are readily recovered or may be inoculated into another animal....

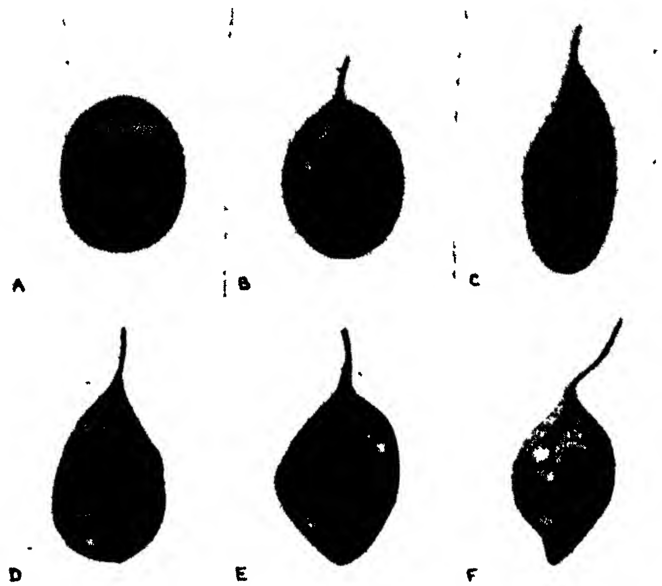


Figure 53—*Trypanosoma cruzi* Chagas from heart muscle of albino rat: **A**, leishmaniform stage; **B–C**, crithidial stages; **D**, transitional stage between crithidia and trypanosome; **E–F**, trypaniform stages. (After Kofoid and Donat (1933); figure loaned by Fae Donat Wood.)

Chagas' disease occurs in man throughout most of South and Central America from Argentina to Mexico. In Argentina, Mazza found 33 percent of 1722 bugs examined to be infected and 240 acute human cases with a fatality of 5.8 percent between 1932 and 1937. Many subclinical cases were suspected with a general weakened condition from constant reinfection. These latter cases result in myocarditis and early deaths.

There have been a few cases of complications resulting from the bites of this bug brought to the attention of physicians in Honolulu. Two of these have been reported upon by Arnold and Bell (1944:121) as follows:

Case 1. Mrs. E. R., a housewife, consulted one of us (D.B.B.) on March 28, 1943, because of 6 elevated red lesions, 1 to 3 cm. in diameter, on the inner aspect of the right forearm. These had awakened her by itching and burning early in the morning, and had later become reddened, swollen, and painful. At the time she was seen, a few hours after awakening, lymphangitis and axillary adenitis were present. The temperature was normal. After about three days the process subsided and the swellings disappeared.

On April 8 she returned with a painful, bluish-red swelling of the distal phalanx of the right fourth finger which had kept her awake all night. A small incision in the area produced free bleeding, but no pus. The pain and throbbing were relieved following the incision, and the swelling subsided. A reddened area on the dorsum of the middle phalanx could then be identified, which looked like the site of an insect bite.

The following day she returned with a red, painful, elevated lesion above the right eye, and redness and swelling of the eyelids on that side. On that day the patient was able to find and kill, in her bed, a large bug which was identified by C. E. Pemberton . . . as *Triatoma rubrofasciata* (Degeer).

Case 2. Mrs. C. W., housewife, was seen by one of us (H.L.A., Jr.) on November 2, 1943, because of a painful, sharply outlined, elevated papule about a half inch (12 mm.) in diameter on the ulnar edge of the left hand. She said she had been awakened about 2 o'clock that morning by intense itching and burning in that area, and that the lesion had gradually become painful and swollen.

When she was examined, some eight hours later, there was a broad, bright red streak extending from the involved area to the axilla, and decided tenderness in the axillary area. The following day the swelling and pain were more marked, despite the use of hot hypertonic saline compresses and elevation of the arm, and an incision was therefore made in the succulent-looking plaque on the hand. Serum and a little blood were obtained. Forty-eight hours later the swelling had subsided and the redness was fading.

The patient admitted having seen bugs in her house which answered the description of *Triatoma rubrofasciata*, and on the following day brought two live adult specimens to the office. Her home, like that of the first patient, was in Kaimuki, a dry, moderately elevated residential district on the southeast edge of Honolulu....

In January, 1944, I captured a female *Triatoma* which was flying about my bedroom at night, and from it I obtained a series of eggs and conducted some limited studies. The eggs are about 1.1×1.9 mm. in size, very shiny, creamy white, minutely sculptured, and they have a hard shell. If dropped, they rebound as though they were hard rubber pellets. One egg laid on February 10 hatched on March 7. The eggs were laid free and were either deposited in the cotton plug of the vial in which the female was confined, or were laid loose in the vial. In a vial covered with net, the female laid the eggs through the net meshes so that they dropped outside the confining vial. Eggs were laid at unequal intervals and at varying rates, perhaps as the result of artificial conditions and improper feeding. About 20 eggs were laid over a period of 20 days. The eggs become pinkish as embryonic development progresses, the dorsum collapses and becomes concave over the abdomen of the embryo so that it appears as if the eggs were spoiled. The black eye spots are plainly visible through the shell.

A first instar nymph was fed on my wrist on March 6. It selected one of the small wrinkles on the underside of the wrist to pierce. There was no sensation while it was feeding and no after effects. It fed continuously for 14.5 minutes and then released at repletion. At feeding, the abdomen first elongated and then swelled and became a beautiful cherry red as it filled with blood. At repletion the abdomen measured 2.75 mm. long (including the metanotum which merged with it), 2.2 mm. wide and 1.9 mm. high. The abdomen became so tightly swollen that the intersegmental lines became faint and the anus became terminal. (In the unfed nymph, the abdomen was depressed, the intersegmental lines well-marked, 1.1 mm. long to the mesonotum, 1.1 mm. broad, and the anus lay under the hind edge. The unfed nymph measured 2.5 mm. along the median line, and the fully fed nymph 4.25 mm. long.) On March 7, the abdomen had turned a dull black, was still tumid, and no feces were seen. By March 10 and 11 the ends of the abdomen had become brownish, otherwise there was no change, and no feces were seen. The specimen molted between March 17 and 24 during my absence from the laboratory. It fed for 15 minutes on my wrist on March 31, and there were very faint sensations as the beak was inserted. It died in molting on April 27.

A second lot of five nymphs were fed on a guinea pig. These were first fed on March 11. These molted between March 17 and 27, four of them by the 24th. One molted for the second time on May 14 or 15, one died molting on May 16, another died molting on May 17. The fourth was killed by the guinea pig host. The fifth molted again on June 19, again on July 23 or 24 and molted to an adult male on September 19. It died on December 16 of starvation.

A third lot of two first instar nymphs fed for 15 minutes on my wrist on March 13. No sensation was caused by their feeding. After several hours red spots 3 to 5 mm. across and which itched like mosquito bites appeared at the puncture sites. The itching lessened on March 15 and the red spots were reduced in size, although they were still somewhat itchy on March 16. One example molted on March 29, the other on the 30th. On March 31 I fed the specimen which had molted on the 29th on my wrist (the other failed to feed). No sensation was experienced, and a very slight, hardly noticeable pink color developed about the inserted beak, and this gradually spread. Eighteen minutes were needed to feed to repletion. A slight itching was noticed after 15 minutes and the pink spots enlarged to 2 mm. in diameter. On April 1 the spots had spread to 1 cm. in diameter, were red and itched. On April 3 the spots were reduced to 3 mm. in diameter, but they were still somewhat itchy. On April 5 they had reduced to 1.5 mm. across and were elevated. On April 6 the second nymph fed on my wrist for 19 minutes. The itchy bites spread as red spots to about 1 cm. in diameter. It should be noted that red spots appeared at the puncture sites even if the bug fed at the spot for only a moment. Thus, if the bug did not feed continuously at one place, a red spot developed for each puncture made. One of the nymphs molted on May 12, the other on May 18. One molted on July 9 or 10, again on August 9 or 10, and it emerged as an adult female on October 20. It was fed part full on October 31 and was not fed again before it died on December 1.

The itching was so annoying that I discontinued feeding the bugs on myself and used guinea pigs for the purpose. The guinea pigs were bothered by the bites also, and one female, after being fed upon several times, trembled violently every time I tried to feed the bugs on her and became useless as an experimental host.

The bugs frequently refused to feed. As can be seen from the above notes, they can go a long while without feeding. Adult specimens, when fed to repletion, frequently fed continuously for half an hour, and from two to three hours or more elapsed before defecation of the dark, digested blood took place. None of the specimens studied passed feces during or shortly after feeding as has been reported for several other species.

When attacking, the bugs use stealth and carefully approach their objective. When in a favorable position, they extend their beaks forward, raise up on their legs, and then drive their proboscis into the host with a startling, lightning-like thrust which, surprisingly enough, is not or is hardly felt by the host. The bugs are easily disturbed, especially when beginning to feed.

In contrast to the painless piercing when the bug attacks to feed, is the sharp and painful wound it inflicts in self-defense. Thus, if a bug is picked up in the

fingers, it may "bite" viciously in its attempt to get away and at the same time throw off an offensive musk. Reports have come to hand of persons being bitten by some insect while gardening, and the blame has been placed upon *Triatoma.* This is highly improbable, I believe, for the wounds more probably were inflicted by scorpions, centipedes or perhaps spiders. *Triatoma* are secretive insects which are normally active and attack at night, and if disturbed in the daytime they will attempt to get away to hiding with much speed and agility. They do not feed if excited or annoyed.

Subfamily HARPACTORINAE (Amyot and Serville)

Assassin Bugs

We have in Hawaii a single immigrant representative of this, the largest subfamily of the Reduviidae. The presence of a pair of ocelli and a much stouter body easily serve to distinguish it from the Ploiariinae. Its very different head and rostrum together with the fact that the connexivum is almost or entirely hidden by the hemelytra, whereas it is broadly exposed in the Triatominae, distinguish it from the Triatominae.

Genus **ZELUS** Fabricius, 1803

This is a large, mostly tropical American genus.

Subgenus **Diplacodus** Kirkaldy, 1900

Zelus renardii Kolenati (fig. 54).
Zelus renardii Kolenati, 1856:460, pl. 3, fig. 2.
Zelus peregrinus Kirkaldy, 1902:149.
Bionomics: Swezey, 1905:232–234, pl. 16, figs. 1–3. Kirkaldy, 1907:156–158.

The leafhopper assassin bug.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii.

Immigrant. A western North American species described from California. First found in Hawaii near Honolulu by Perkins in 1897.

This is a common, widespread, predaceous insect which frequents many kinds of plants and feeds upon almost any arthropods it can catch and hold. "An example of their voracity is shown by the following observation: 17 adult [sugarcane] leaf-hoppers were confined with an adult female *Zelus,* and within 24 hours she had eaten 14 of them. The same female ate flies of various species; ladybugs, young and adult; spiders; nymphs of her own species; and, in fact, one day ate the adult male which was confined with her; in another instance a full grown nymph ate an adult which had just molted and was still soft and unprotected." (Swezey, 1905:233.) During the great outbreak of the sugarcane

leafhopper, this species was abundant in the sugarcane fields where it played a beneficial role in reducing the numbers of leafhoppers. It feeds upon aphids, but may also feed upon ladybird beetles which feed upon aphids and coccids, thus, in part, nullifying some of its beneficial work. The young nymphs have been observed feeding on "red spiders." "It preys upon very different kinds of insects, and the adults will destroy many kinds of beetles such as Dermestids, Coccinellids, and Tenebrionids, and even the hard Hymenopterous genus *Chalcis*. The young feed on softer creatures, especially *Aphis,* young leaf-hoppers, etc., which are also attacked by the mature bugs." (Perkins, 1913:cxcix.)

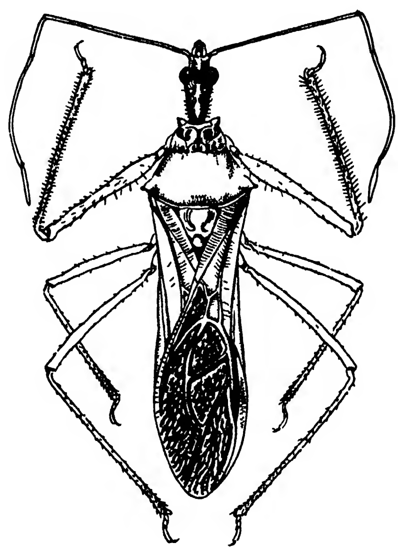


Figure 54—*Zelus renardii* Kolenati, the leafhopper assassin bug. (Abernathy drawing.)

The subcylindrical, brown, sticky eggs are between 1.2 and 1.5 mm. in length, the operculum is whitish and is depressed below a raised peripheral fringe. They are deposited in columnar clusters, each usually containing 20 to 40 or more eggs. A female observed by Swezey laid 269 eggs during a period of a little more than a month in batches that averaged five days apart. The incubation period is 8 to 10 days.

The nymphs are more or less sticky in all stages. The abdomen is rather ovate in shape and somewhat flattened above; in the younger stages it is much tilted up behind. Eyes red; legs white, ringed and spotted with black; stages 1 and 2 have black spines at tip of abdomen; 3, 4 and 5 have the spines also on the sides of the abdominal segments, increasing in size from before backwards. Full grown nymph is of a light bluish green color, with some reddish yellow markings on dorsum, segmentally arranged. (Swezey, 1905:234.)

Kirkaldy (1907:157–158) gave a detailed description of the fifth instar nymph. There are probably about four to six generations a year. An entire life cycle may take a few days less than two months.

Family NABIDAE (Costa, 1852) Dohrn, 1859

Nabids, Damsel Bugs

This cosmopolitan group of predaceous bugs is united with the Reduviidae by some workers. Many of our species resemble the reduviid *Zelus*. The prosternum lacks the specialized stridulatory groove characteristic of the Reduviidae; the rostrum has four instead of three segments, and it is also longer in our species than in the Reduviidae, for it extends well behind the fore coxae. The antennae are four-segmented. Two ocelli are usually present, but are obsolescent in some forms and absent in others. Our species either have the wings fully developed with the hemelytra with clavus, corium and membrane distinct and the veins conspicuous in all three parts, or they are variously modified and reduced so that some species are brachypterous or micropterous. The tarsi are three-segmented; the claws lack arolia. The female ovipositor is well developed, and the male genital claspers are large and conspicuously exposed at the sides of the end of the abdomen. The eggs are inserted in plant tissues, an unusual habit for the reduviid series of families.

This is one of the most specifically complexly developed groups of bugs in the Hawaiian Islands and is one of the most intriguing groups of all Hawaiian insects from an evolutionary standpoint.

Subfamily NABINAE (Reuter, 1890)

Tribe NABINI Van Duzee, 1916

Genus NABIS Latreille, 1802

Reduviolus Kirby, 1837.
Coriscus Stål, 1873.
Milu Kirkaldy, 1907.
Nesotyphlias Kirkaldy, 1907.
Nesomachetes Kirkaldy, 1908.

Genotype: *Cimex ferus* Linnaeus, fixed by Westwood, 1840.

This genus contains 26 described forms in the Hawaiian Islands, but there is a large number of undescribed species known to us. Some of these new species are among the finest in the genus. We may learn that there are more than 50 species here. In contrast to this, Harris in 1928 listed 22 species from all of America north of Mexico. The native Hawaiian species "...may very reasonably be considered to have all developed from one original immigrant, possibly indeed from *R. blackburni*." (Kirkaldy, 1909:49.)

The great differences in the development of the tegmina and wings among our many species of *Nabis* are remarkable and offer a magnificent field for studies in evolution. The species can be divided into two major groups. The first group contains the more primitive or conservative species, or those normal, fully winged insects capable of active flight. The second group consists of radically changed species with wings and tegmina reduced to various stages of obsolescence or abortion, and none of these insects can fly. Some of them have the tegmina as long as or longer than the abdomen, and there is a series of forms (including undescribed species) which grades down to species in which the tegmina are reduced to mere coriaceous flaps. In all of these flightless forms, the corium and clavus are not sharply demarked one from the other, and in all the membrane is reduced or is vestigial. The hind wings are vestigial in all of them. In the winged forms, the ocelli are normal and fully developed, whereas they are obsolescent or absent in the brachypterous forms. In the flying forms the hind lobe of the pronotum is strongly developed and the middle lobe is on a somewhat lower plane. However, on the flightless forms, the middle lobe is strongly developed, is tumid, and, in most species, it rises high above the posterior lobe.

Among all of our many species, there is only one known form which tends to bridge the gap between these two groups of species. This is *Nabis blackburni,* the most widely distributed of our endemic species and the one which has been reported from the largest number of hostplants. Specimens from the high or wet mountains display a unique variability in the development of the tegmina and hind wings, and in some examples these organs are reduced to the point where the specimens can be called brachypterous, although the development does not go as far as it does in our normally flightless species. In this one species, the lobes of the pronotum vary as do the wings, and on the brachypterous forms the middle lobe is more elevated than is normal for the species. However, the ocelli remain fully developed, even in the most brachypterous examples examined.

The male genital claspers, or parameres, afford excellent means for the separation of most of the species. These organs lie exposed on either side of the genital capsule and are usually examined easily without dissection. The apical part of the claspers may be hidden beneath the posterior edge of the tergite next in front of the genital capsule, and thus the shape may appear to be different than it is if one does not check his specimen carefully. In interpreting the camera lucida sketches of the claspers, one should keep in mind that in nature the organs are twisted and bent in various ways which cannot be shown adequately in such outlines. In drawing them, I have oriented the specimen so that the broadest lateral view was obtained.

One might expect predaceous bugs such as these to be catholic in their hostplant relationships, for they feed upon psocids, nymphal orthopterans, Diptera and other small, soft-bodied insects which are found on a variety of plants. However, the species appear to have definite hostplant preferences. For example, *kahavalu* is attached to *Sophora, tarai* to *Styphelia, subrufus* to *Metrosideros* and *truculentus* to *Pipturus.* The widespread *blackburni* and *capsiformis* have been reported from

many kinds of plants. Other species appear to be attached to given plants, but our information is incomplete. The flightless forms are usually ground, grass, sedge, fern and herb frequenters, although some of them overlap into shrubs and trees. At least some of the species attached to *Metrosideros* have a reddish or dark coloration that is characteristic of other native groups of Heteroptera and Homoptera attached to that myrtaceous tree. I feel that a detailed study of the hostplant relationships of these predaceous insects would be a profitable undertaking that might cast new light on evolutionary problems.

If one is accidentally bitten by a *Nabis*, the wound is apt to swell and form a red welt accompanied by pain for a considerable time.

It is unfortunate that Kirkaldy's several papers on this splendid group have created such confusion. Several of his one-sentence descriptions are worthless, and even some of his more detailed descriptions do not include enough comparative matter to enable identifications to be made. For example, his description of the unique female holotype of *silvicola* reads, in addition to size and locality, "Scarcely to be distinguished from *lusciosus*, but the membranal venation is different and the ocelli more distinct." Another original description states simply "*Kahavalu* sp. nov. *R. innotatus* Kirkaldy, an endemic Hawaiian form; (not Blackburn)." In his papers he misidentified, misinterpreted, combined or separated various forms in a variety of incorrect ways. Although he examined Blackburn's types, he confused the species. Many of the locality and distribution records in his work are confusing, unreliable or inaccurate.

Hence, the task of revising the group is not an easy one. However, it is fortunate that there have been available for study fairly extensive and representative collections. I have before me the holotypes of the four species described by Blackburn, the one species described by Van Duzee, and two of the forms described by Kirkaldy. Cotypes of some of Kirkaldy's other species are also at hand. Kirkaldy examined White's types and correctly interpreted the species.

In Kirkaldy's first paper (in *"Fauna Hawaiiensis,"* 1902), he listed eight species in *Reduviolus*. In his second paper (1907) he erected the new genus *Milu* to include *"kerasphoron"* (a new name for the species he had confused in his 1902 paper as Blackburn's *rubritinctus*). In his third paper (1907) he erected the new genus *Nesotyphlias* for *lusciosus* and corrected a few errors. In the fourth paper (1908) he listed 25 species and one variety, and erected the new subgenus *Nesomachetes* for his *kahavalu*. In his fifth paper (1909), entitled a revision of the family for Hawaii, he listed 24 species and two varieties, ignored his *Nesomachetes*, dropped his *Milu* as "not worthy of more than subgeneric rank," and his *Nesotyphlias* (p. 192, footnote) was disposed of as not to be "regarded as a genus, but rather as a natural group produced under special circumstances." In his last paper on the group (*"Fauna Hawaiiensis,"* supplement, 1910), he used *Milu, Nesotyphlias* and *Nesomachetes* as subgenera and listed 22 species, ignored his varieties and omitted several species. However, some of this confusion may not have been entirely Kirkaldy's fault. Dr. Usinger has pointed out to me that Kirkaldy's 1910

paper may have been written before his 1909 paper and that he may not have seen the proofs of some of this work.

Kirkaldy erected *Milu* because of its "incrassate first segment of the antennae and the prominent blunt spine arising well in front of the antennal insertion from the side of the head, which I formerly overlooked, but which has been pointed out to me by Dr. Perkins" (1907:247). *Nesotyphlias* was separated from *Reduviolus* "by the absence of ocelli, by the clavus being fused with the corium, and by the minute membrane" (1907:155). *Nesomachetes* was "characterized by the almost straight lateral margins of the pronotum and consequently feeble elevation of the hind lobe, by the immaculate scutellum and non-annulate antennae and legs" (1908:190).

Because of the great between-the-species variability and multiform development displayed in our species, these groups are largely meaningless. If isolated species were taken to compare with a normal group of bugs from a continent, a taxonomist would perhaps have little choice but to erect several distinct genera for them. However, in this insular fauna such startling divergent types are obviously allied

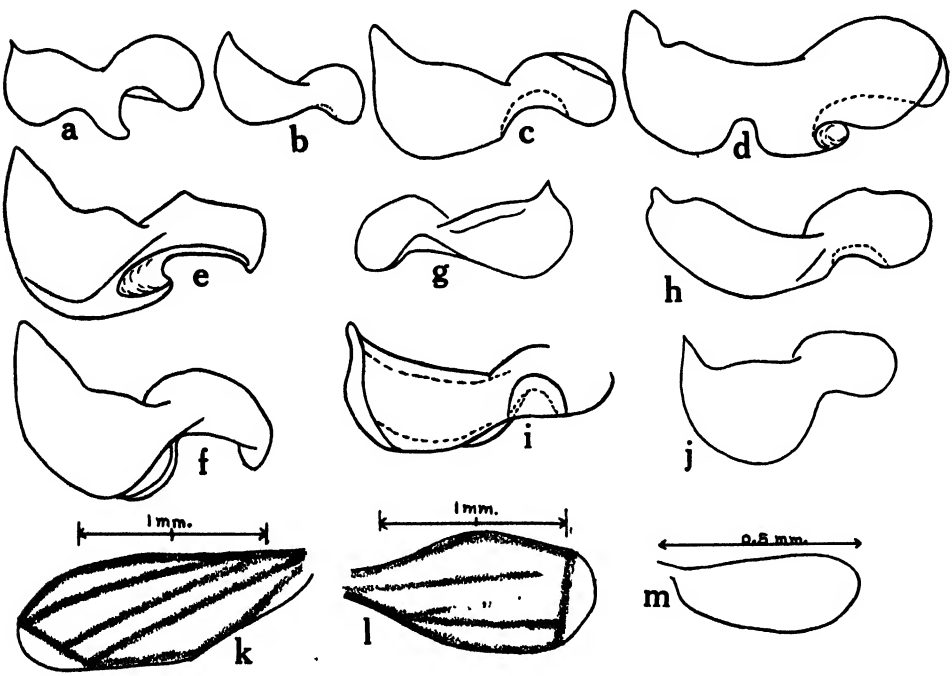


Figure 55—Features of *Nabis* species: **a,** left male clasper of *N. blackburni* White; **b,** the same of *N. capsiformis* Germar; **c,** the same of the holotype of *N. giffardi* Van Duzee; **d,** the same of *N. kahavalu* (Kirkaldy), cotype; **e** and **f,** the same of *N. curtipennis* Blackburn, holotype (**e,** viewed more ventrally oblique, **f,** viewed more dorsally oblique); **g,** right clasper of *N. kaohinani* (Kirkaldy), holotype; **h,** left clasper of *N. kerasphoros* (Kirkaldy); **i,** the same of *N. koelensis* Blackburn; **j,** the same of *N. lolupe* (Kirkaldy); **k,** left hemelytron of *N. kaohinani* (Kirkaldy), male holotype; **l,** the same of a male *N. lolupe* (Kirkaldy) (the middle vein is developed in the two females I have seen); **m,** hind wing of *N. curtipennis* Blackburn, holotype.

specific developments, in some instances very closely allied genetically, and many intermediate species exist, some of them side by side in the field. Kirkaldy put it aptly when he said (1909:57) "I have proposed a mutation-name, *Nesotyphlias*. It is not strictly a genus, or even perhaps a subgenus in an exotic sense, but it is certainly not equivalent to the ordinary brachypterous forms of the genus in Europe and North America. *The Hawaiian fauna is very peculiar and must be treated in a special manner.*" [Italics mine.] There is only one species (including a color variety) with the cephalic horns of "*Milu kerasphoron,*" but the horns represent a simple enlargement of less-developed processes found on all of the species. In this work, Kirkaldy's subgenera are not used.

The types of the species in the British Museum were checked through the following key by Mr. W. E. China. His cooperation is gratefully acknowledged.

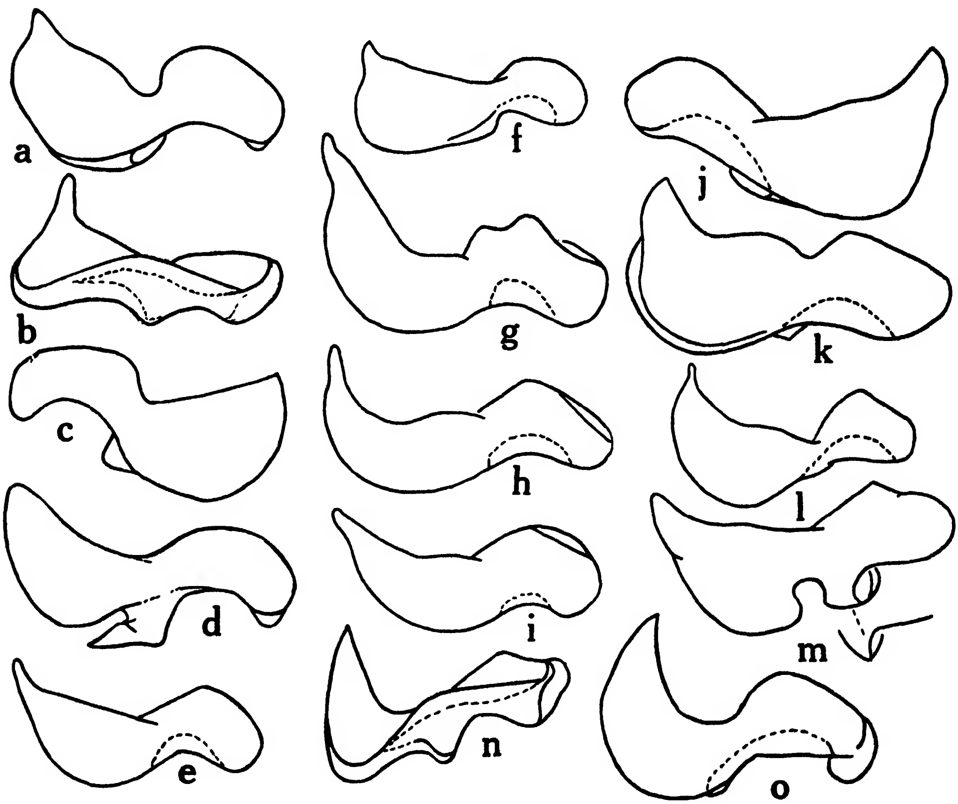


Figure 56—Lateral views of male genital claspers of *Nabis* species: **a, b,** *N. lusciosus* White (**b,** oblique from beneath), left clasper; **c,** *N. pele* (Kirkaldy), right clasper; **d,** *N. procellaris* (Kirkaldy), left clasper; **e,** *N. truculentus* (Kirkaldy), left clasper; **f,** *N. morai* (Kirkaldy), left clasper; **g,** *N. nubigenus* (Kirkaldy), left clasper of cotype from Molokai; **h,** left clasper from the same species, but from an example from Maui; **i,** left clasper from the same species, but from an example from Lanai; **j,** *N. oscillans* Blackburn, right clasper of holotype; **k,** *N. rubritinctus* Blackburn, left clasper; **l,** *N. subrufus* White, left clasper; **m,** *N. tarai* (Kirkaldy), left clasper; **n, o,** *N. silvestris* (Kirkaldy), left clasper (**n,** from oblique beneath).

Key to the Hawaiian Species of Nabis

1. Ocelli conspicuous and well-developed; middle lobe of pronotum not strongly convex as noted below, but on a somewhat lower plane than posterior lobe (except in *nesiotes* and some specimens of *blackburni*) 2

Ocelli absent or obsolescent (see *silvicola*, fig. 68, for example of obsolescent ocelli); middle lobe of pronotum tumid and usually strongly convex so that when viewed from side its middle part is on a higher plane than either anterior or posterior lobes; wings reduced 17

2(1). Head with a conspicuous, remarkable, stout, upturned horn on either side of median line in front of bases of antennae; first antennal segment incrassate................ 3

Head without such horns.............................. 4

3(2). Basal part of tegmina as far as beginning of membrane distinctly paler than remainder of corium which is thus bicolored; Oahu.....**kerasphoros kerasphoros** (Kirkaldy).

Corium not bicolored, but entirely predominantly reddish; Oahu...........**kerasphoros purpureus** (Kirkaldy).

4(2). First antennal segment not longer than median length of pronotum (do not include basal antennal tubercle in measurement), usually distinctly shorter, rarely about as long 5

First antennal segment longer than pronotum, length usually equal to length of pronotum plus back of head up to ocelli...13

5(4). Stout or comparatively stout brownish species with clavus and corium set with numerous, conspicuous, large, coarse, irregular punctures which are darker than surrounding derm 6

Tegmina without such coarse punctures, or with some limited to outer apical part of corium; mostly comparatively elongate species............................. 7

6(5). Membrane of tegmina with veins not greatly broken up, but mostly line-like; first antennal segment longer than breadth of head through eyes; apical part of male genital clasper broad and rounded with a small, dorsal, tooth-like point; Kauai.....................**morai** (Kirkaldy).

Veins of membrane conspicuously broken up to form many spots and isolated patches; first antennal segment shorter than breadth of head through eyes; apical part of male clasper acuminate and more sickle-shaped; Lanai, Maui, Molokai ....**nubigenus** (Kirkaldy).

7(5). Widest part of pronotum at least twice as broad (in most species more than twice as broad) as breadth of head through eyes (only twice as broad in *kahavalu*) (this is a weak part of the key and may require revision)....... 8

Widest part of pronotum less than twice as broad as head across eyes 11

8(7). Corium conspicuously bicolored, anterior half yellow, posterior half red; Kauai............**sharpianus** (Kirkaldy).
Corium entirely or almost entirely predominantly yellowish or brownish, or variously tinged with red, but never bicolored as in *sharpianus*.......................... 9

9(8). An outstanding and unusually marked species from Oahu; dorsum basically pale brown entirely marked with numerous darker brown lines and dark areas; membrane pale with veins dark and very prominent even to unaided eyes; veins on corium alternating pale and dark colored; posterior lobe of pronotum prominently multivittate ....**truculentus** (Kirkaldy).
Not such species 10

10(9). Pronotum distinctly more than twice as broad as head through eyes, posterior lobe on a distinctly higher plane than middle lobe; a yellowish-brown species with some veins of densely opaque corium tinged with red, or entire corium reddish; hind wings dark; femora spotted; Maui ....**rubritinctus** Blackburn.
Pronotum only twice as broad as head through eyes, posterior lobe hardly more elevated than median lobe; in life pale green, fading to pale yellowish or yellowish-brown after death; tegmina pale, translucent or milky subtranslucent; membrane not very sharply marked off from corium in texture; hind wings pale; femora pale, not spotted; a conspicuously pale species with characteristic male genital claspers, as illustrated (fig. 55, d); Hawaii ....**kahavalu** (Kirkaldy).

11(7). Middle lobe of pronotum distinctly convex and raised above level of posterior lobe; general color dark chocolate-brown, underside pitchy black....**nesiotes** (Kirkaldy).
Middle lobe of pronotum not convex nor raised above level of posterior lobe; general color grayish-yellow or reddish-brown, underside pallid........................11a

11a(7). Entire insect, especially dorsum, tinged with pinkish or reddish; male clasper as illustrated (fig. 56, m); on all main islands........................**tarai** (Kirkaldy).
Species predominantly grayish, yellowish and brownish and not conspicuously tinged with red....................12

12(11). Tegmina with numerous dark marks; legs conspicuously spotted; male claspers each with a strongly developed tooth on lower margin as illustrated (fig. 55, a); on all main islands.....................**blackburni** White.
Tegmina nearly uniformly pale in color; legs at most feebly marked; male claspers rounded beneath and without a tooth, as illustrated (fig. 55, b); on all islands ....**capsiformis** Germar.

13(4). Femora, excepting for at most a dark apex, pale and without numerous spots; pale species from Hawaii....... ....**giffardi** Van Duzee.
Femora with many distinct spots......................14

14(13). An outstanding and unusually marked species from Oahu; dorsum basically pale brown entirely marked with numerous darker brown lines and dark areas; membrane pale with veins dark and very prominent even to unaided eyes; veins on corium alternately pale and dark colored; posterior lobe of pronotum prominently multi-vittate (Note: Although the specimens I have seen actually belong in 4(2) above, I have placed the species here also, because the first antennal segment is nearly as long as the pronotum, and unless carefully measured it might be run to this section of the key.) ..... **truculentus** (Kirkaldy).

Not such species 15

15(14). Tibiae normally conspicuously multi-annulate, rings of color usually obvious to unaided eyes (an occasional confusing specimen has the rings hardly visible, however); Oahu .... **subrufus** White.

Tibiae concolorous (at most only apex dark, never multi-annulate); not Oahu species......................... 16

16(15). Male clasper terminating in a broad, comparatively blunt apex as illustrated (fig. 56, j); Hawaii............... .... **oscillans** Blackburn.

Male clasper terminating in a more slender, sharper apex as illustrated (fig. 55, i); Lanai and Hawaii.......... .... **koelensis** Blackburn.

17(1). Tegmina, even if abbreviated, reaching behind fifth abdominal segment 18

Tegmina greatly abbreviated, at most reaching only slightly behind first abdominal segment, membrane nearly obsolete; antennae at least in part conspicuously multi-annulate 22

18(17). Tegmina obviously shorter than described below and always leaving genital capsule and usually one or two other abdominal segments exposed behind; male genital capsule always exposed; male claspers as illustrated (fig. 55, e, f); Hawaii................ **curtipennis** Blackburn.

Tegmina reaching to or beyond apex of abdomen (an occasional gravid (?) female may have part of genital segment exposed, but genital capsule always concealed in males) 19

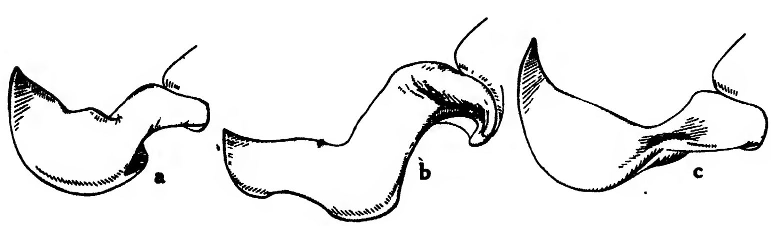


Figure 57—Lateral views of male genital claspers of *Nabis* species: **a**, *N. curtipennis* Blackburn (from the holotype of *Reduviolus volcanicola* Kirkaldy); **b**, *N. nubicola* (Kirkaldy), holotype; **c**, *N. paludicola* (Kirkaldy), holotype. (Drawn at the British Museum of Natural History by Smith.)

19(18). Molokai species 20
Not so 21

20(19). Male genital capsule with each exterior angle behind and below attachment of each clasper produced as a stout, conspicuous, boss-like protuberance (best seen when viewed from rear); claspers each with a peculiar, forward-projecting, sharp, hook-like process on lower midsection (fig. 56, d); female holotype as illustrated (fig. 67), with hemelytra with extreme length of inner edge of membrane shorter than clavus, middle apical cell of corium shorter than pronotum......**procellaris** (Kirkaldy).
Male unknown; female holotype as illustrated (fig. 68), with extreme length of inner margin of membrane longer than clavus, middle apical cell of corium longer than pronotum (these lengths vary somewhat individually, and the cell may not be quite as long as the clavus, but the hemelytra are obviously more slender with longer cells, as illustrated, than those of *procellaris*).........
..............................**silvicola** (Kirkaldy).

21(20). Hawaii species; male clasper as in figure 56, c..........
..................................**pele** (Kirkaldy).
Maui species; male clasper as in figure 57, b...........
..............................**nubicola** (Kirkaldy).
Oahu species; male clasper as in figure 56, a, b.........
..................................**lusciosus** White.
Kauai species; male clasper as in figure 56, n, o........
..............................**silvestris** (Kirkaldy).

22(17). Corium nearly truncate behind, membrane thus situated more transversely than obliquely; Kauai..**lolupe** (Kirkaldy).
Corium strongly oblique apically which in turn results in membrane being placed obliquely; Oahu and Molokai species.......................................23

23(22). Molokai species; first antennal segment distinctly multi-annulate; middle lobe of pronotum strongly convex, rather bulbous as seen from side.....**paludicola** (Kirkaldy).
Oahu species; first antennal segment not obviously annulate; middle lobe of pronotum moderately convex......
..............................**kaohinani** (Kirkaldy).

Nabis blackburni White (figs. 55, a; 58).

Nabis blackburni White, 1878:373.

Reduviolus blackburni (White) Kirkaldy, 1902:155, in part; 1909:60, figs. 2, 11, 16, 17.

Endemic. Kauai, Oahu (type locality ?), Molokai, Lanai, Maui, Hawaii. (Kirkaldy lists it from Laysan, but the specimens I have seen from the leeward islands are the often-confused *capsiformis*.)

Hostplants: *Acacia koa, Campylotheca, Deschampsia australis,* ferns, grasses, *Lythrum, Metrosideros, Raillardia, Scaevola,* sedges, *Sophora, Styphelia,* sugarcane, *Suttonia, Verbena.*

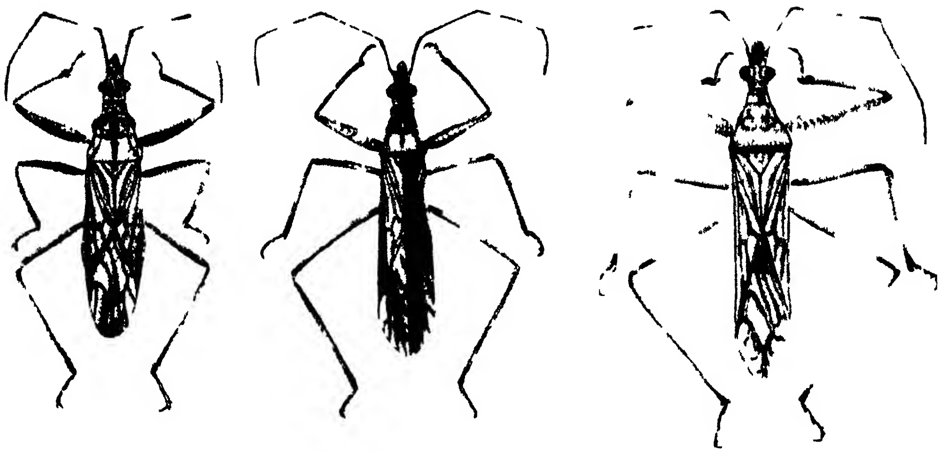


Figure 58—*Nabis blackburni* White, left; *Nabis capsiformis* Germar, middle; *Nabis giffardi* Van Duzee, right. (Abernathy drawings.)

The holotype is presumably in the Perth Museum of Natural Sciences, Scotland.

There has been a surprising amount of confusion regarding this species. It has been taken frequently for *capsiformis,* and many records listed as for this species really belong to *capsiformis.* The species are quite distinct, however, and there is little excuse for not recognizing them, at least in the male sex. *N. blackburni* is a darker insect with dark markings on the tegmina, and the male genital claspers are conspicuously different from those of *capsiformis.* The claspers of *blackburni* have an easily seen, prominent, tooth-like lobe on the ventral edge at about the middle, but in *capsiformis* the ventral edge is continuously arcuate from the subbasal constriction. These differences are shown in the accompanying illustrations and serve to separate the species at a glance.

Nabis blackburni is the commonest and most widespread of our native nabids. It has been collected from one end of the main islands to the other. It is most abundant at higher elevations, but it has been collected in the lowlands also.

This species is remarkable for its tendency toward variation in the development of its tegmina and wings. Kirkaldy (1909:60) and Perkins (1913:cxcvi) both remarked on this. Perkins noted that it

> differs from all the others, in having brachypterous and macropterous forms, as well as somewhat intermediate conditions. It was described, no doubt from macropterous examples, by White... there being no brachypterous specimens in Blackburn's collection. Blackburn's specimens were such as are usually found in drier localities or at lower elevations; truly brachypterous forms inhabit wetter localities or higher elevations in the mountains. I have taken some pains to observe this species at high elevations above 4000 ft. in the mountains, where I have seen it breeding in numbers amongst low sedges. In the most brachypterous form the membrane is much reduced in the female, the tegmina not quite covering the abdomen, while the wings are much shorter, though extending somewhat beyond the middle of the abdomen.

Kirkaldy (1909:60) described the nymph as follows: "The nymph, when living, is dark, purplish-brown above, more or less variegated; scutellum yellow behind.

Beneath pale yellow, abdomen apically more or less fuscate. Femora annulate near the apex. Pleurites spotted with reddish."

Kirkaldy (1907:156) considered this to be an Australian immigrant, but I do not believe that this claim has been substantiated by other workers.

Nabis capsiformis Germar (figs. 55, b; 58).

Nabis capsiformis Germar, 1837:132.

Nabis innotatus White, 1877:112. Blackburn, 1888:352, in part. Kirkaldy, 1907:156. Synonymy by Reuter, Mem. Soc. Ent. Belgique, 15:114, 1908. (I have not seen this reference.)

Reduviolus capsiformis (Germar), of authors.

Reduviolus blackburni, not of White, misidentification by Kirkaldy, 1902:155, in part; 1909:59, fig. 1. The *Reduviolus innotatus* (White) of Kirkaldy, 1902:154, pl. 5, fig. 32, does not apply to this species (see *kahavalu*). Swezey, 1905:234, pl. 18, figs. 1–4, bionomics. Van Duzee, 1917:280, gives extra-Hawaiian synonymy.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii, Nihoa, French Frigate Shoal, Lisiansky, Pearl and Hermes Reef, Laysan, Midway, Ocean, Johnston.

Immigrant. Now nearly cosmopolitan. Considered to be an Australian species by some workers. First recorded from Hawaii by White in 1877. It is widespread among the Pacific islands.

Hostplants: alfalfa, Bermuda grass, *Cyperus,* grasses, potato, sugarcane, taro, various garden and truck crops.

Hosts: sugarcane aphis and leafhopper, in addition to a large number of other similar insects not specifically identified. It has also been reported to feed upon honeydew from the sugarcane leafhopper.

Parasite: *Polynema reduvioli* Perkins (Hymenoptera: Mymaridae), considered to be an immigrant species. It lays one egg in each bug egg attacked.

Nabis capsiformis, a common, widespread species, resembles the native *blackburni,* with which it is commonly confused. It is a paler, more uniformly colored species with conspicuously different male claspers, as illustrated in figure 55, b. It is principally a species of the drier areas and the lowlands, and even finds bunch grass on coral atolls to its liking. The eggs have been found inserted in the stems of grass and in the midribs of sugarcane leaves. Swezey (1905:235, under the confused name *blackburni*), noted that "A female in confinement deposited 15 eggs, singly, in an irregular row in a cane-leaf. Two of these hatched in 10 and 11 days respectively. The nymphs were slender, of a pale yellow color. They molted 5 times at intervals of about 5 days (3–7), and matured in 24 days."

Bryan (*Proc. Hawaiian Ent. Soc.* 8(2):237, 1933) reported that what he thought was this species "was found sucking blood from the baby, having raised three small welts on his neck."

China, in *Insects of Samoa* (1930:157) has the following to say:

The Samoan specimens agree very well with the type of the Hawaiian *R. innotatus* B. White, which is apparently teneral. Reuter has identified this species with the almost cosmopolitan *R. capsiformis* Germar. With this I am not entirely in agreement, for, although as pointed out by Reuter this species is very variable, it seems more than probable that several subspecies, at least, are involved. Apart from the question of pterygo-dimorphism, the Pacific Island forms differ markedly from the typical Mediterranean and South African form in the much smaller size of the membrane. The hind femur and the second antennal segment in the Samoan specimens are distinctly longer than in Hawaiian specimens, although the shape of the male parameres is the same.

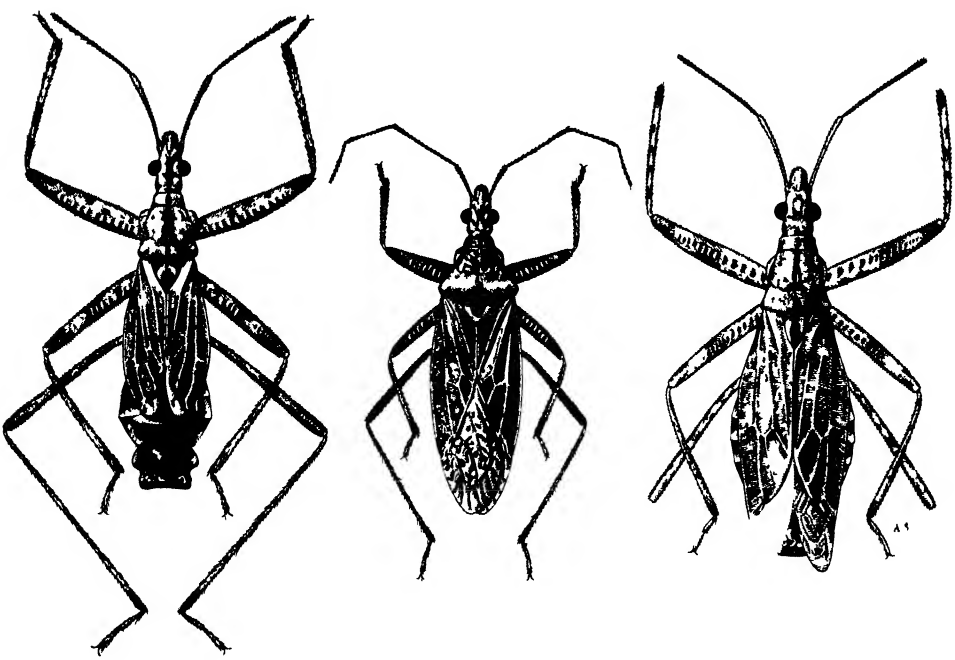


Figure 59—*Nabis curtipennis* Blackburn, drawn from the male holotype of *volcanicola* (Kirkaldy), left. *Nabis morai* (Kirkaldy), female holotype, middle. *Nabis nubicola* (Kirkaldy), holotype male, right. (Drawings made at the British Museum of Natural History by Smith.)

Nabis curtipennis Blackburn (figs. 55, e, f, m; 57, a; 59).

Nabis (?) *curtipennis* Blackburn, 1888:353.

Reduviolus curtipennis (Blackburn) Kirkaldy, 1902:157, incorrectly synonymized under *lusciosus*, pl. 5, figs. 34, 34a; 1908:193; 1909:68; 1910:549.

Reduviolus volcanicola Kirkaldy, 1908:193, type in the British Museum. New synonym.

Endemic. Hawaii (type locality: near Waimea).

Hostplants: tree ferns, in ground litter.

This brachypterous species confused Kirkaldy. When he had Blackburn's type

in hand he considered it to be a synonym of *lusciosus*. Later he ignored his earlier observations and gave it a new name. I have before me Blackburn's holotype (now in the Bishop Museum collection) and a series of specimens taken by Perkins, some of which were examined by Kirkaldy, and the above synonymy is indicated. Mr. China also found that the holotype of *volcanicola* runs to this species in the key.

The dorsum of the abdomen has a pinkish color in the male, but it tends to dry dark in the female. The femora and tibiae are annulated, the tibiae less darkly than the femora.

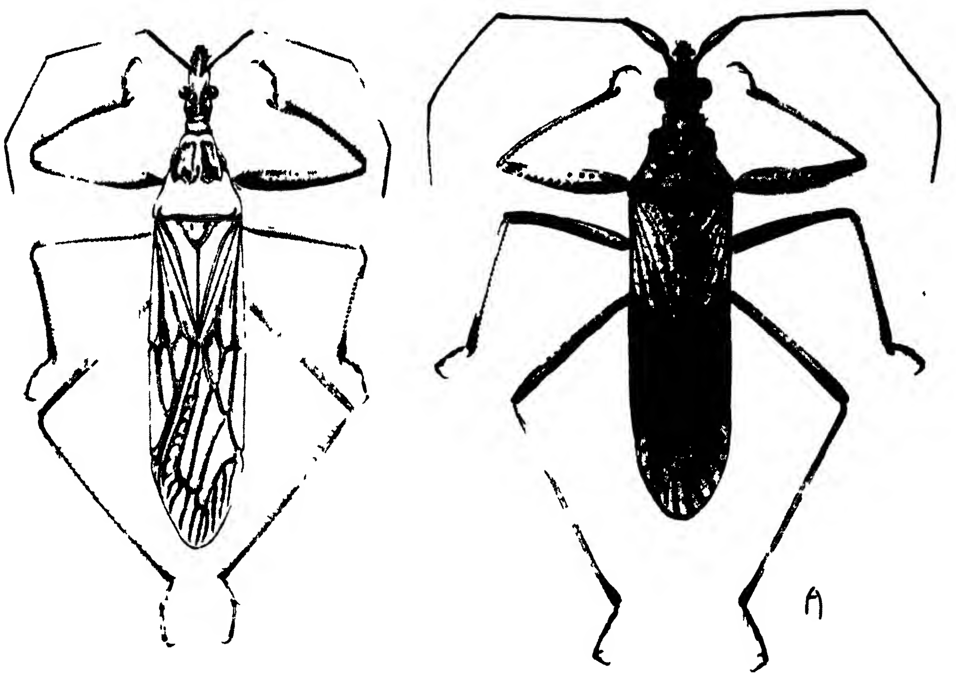


Figure 60—*Nabis kahavalu* (Kirkaldy), left. *Nabis kerasphoros* (Kirkaldy), right. (Abernathy drawings.)

Nabis giffardi Van Duzee (figs. 55, c; 58).

Nabis giffardi Van Duzee, 1936:226.

Endemic. Hawaii (type locality: South Kona Road, 1,900 feet).

This is a pale form which has a variable amount of dark coloring on the dorsum. The holotype is in the Bishop Museum.

Nabis kahavalu (Kirkaldy) (figs. 55, d; 60).

Reduviolus kahavalu Kirkaldy, 1907:156; 1909:61; 1910:546.

Misidentified as *Reduviolus innotatus* (White) by Kirkaldy, 1902:154, pl. 5, fig. 32.

Reduviolus (subgenus *Nesomachetes*) *kahavalu* (Kirkaldy) Kirkaldy, 1908:190.

Endemic. Hawaii (Kirkaldy designated no type locality, but his specimens came from Kona and Kilauea. His Oahu record was in error, as he pointed out in 1909:61).

Hostplants: attached to *Sophora chrysophylla* ("mamani"), *Dodonaea* (accidental ?).

This is perhaps the palest of all of our species. The tegmina and wings are nearly clear on some examples so that the abdomen partly shows through. It is a striking green color in life, but dries to whitish, yellowish and pale brownish. Some examples have a decided iridescent cast to the tegmina and wings. The male claspers are peculiar and diagnostic (see fig. 55, d). It occurs from 4,000 to 8,000 feet or higher where its leguminous hostplant is found. It is a splendid species in life.

There is a series of cotypes in the Bishop Museum's share of the *Fauna Hawaiiensis* collection; the holotype is in the British Museum.

The records by Bryan and Swezey (1926:80) listing the species from Nihoa and Wake Islands are in error. Their Wake Island specimen is evidently a nymph of *capsiformis*, but the Nihoa Island material represents a fine new species.

Nabis kaohinani (Kirkaldy) (figs. 55, g, k; 61).
Reduviolus kaohinani Kirkaldy, 1909:68.

Endemic. Oahu (type locality: Kaumuohonu).

The only known specimen of this very short-winged species is the male holotype collected by Swezey which is now in the collection of the Hawaiian Sugar Planters' Association Experiment Station.

Kirkaldy recorded the locality data as "Oahu, Tantalus, about 2000 ft." in his original description. His record is erroneous, for the label on the holotype reads "Oahu, Kaumuohonu, Jun. 08. O.H.S."

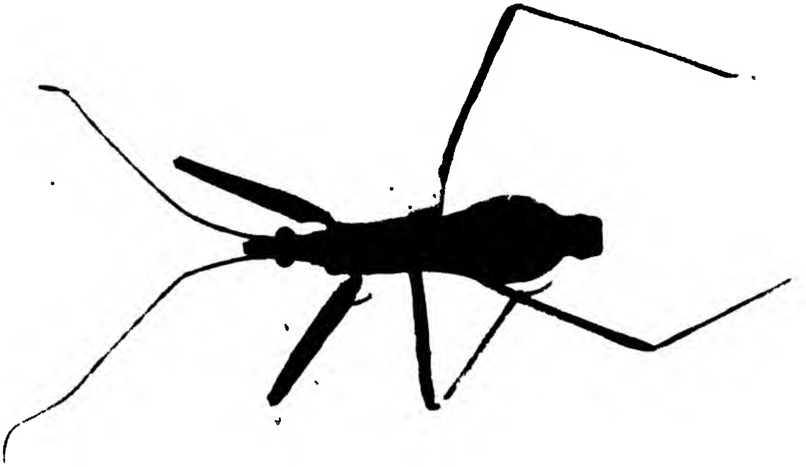


Figure 61—*Nabis kaohinani* (Kirkaldy), holotype male.

On the holotype, the tegmina are as long as the pronotum plus the "neck" of the head, their three veins are prominent, and the tiny membrane is obliquely placed on their inner hind edges.

Nabis kerasphoros kerasphoros (Kirkaldy) (figs. 55, h; 60).

Milu kerasphoron Kirkaldy, 1907:248.

Reduviolus rubritinctus, misidentification by Kirkaldy, 1902:157, pl. 5, fig. 33.

Milu kerasphoros Kirkaldy, 1908:194.

Reduviolus kerasphoros (Kirkaldy) Kirkaldy, 1909:65.

Reduviolus (subgenus *Milu*) *kerasphoros* (Kirkaldy) Kirkaldy, 1910:549.

Endemic. Oahu (no type locality designated by Kirkaldy).

Hostplants: *Metrosideros, Acacia koa* (?).

This is a large, fine, reddish species which differs from all other Hawaiian *Nabis* in having a pair of upturned, conspicuous, cephalic horns, one on either side of the median line of the head in front of the antennae. The first segment of the antennae is noticeably thickened and somewhat spindle-shaped. In the typical form, the tegmina are yellowish as far as the apex of the clavus, thence mostly reddish. This bicolored pattern is striking.

Cotypes are in the Bishop Museum, and the holotype is in the British Museum.

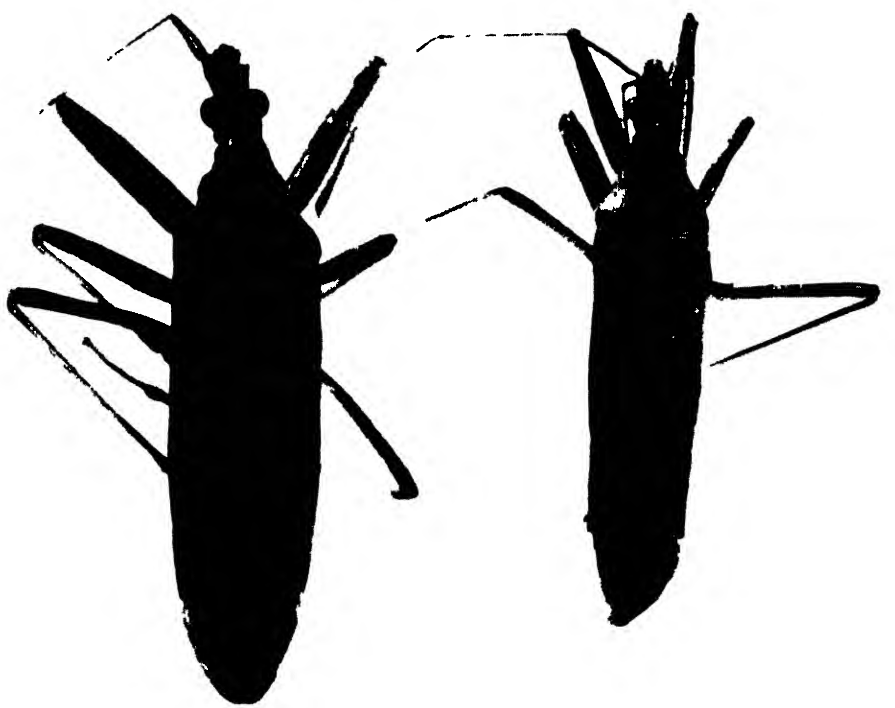


Figure 62—*Nabis kerasphoros purpureus* (Kirkaldy), left. *Nabis rubritinctus* Blackburn, right.

Nabis kerasphoros purpureus Kirkaldy (fig. 62).
Nabis kerasphoros variety *purpureus* Kirkaldy, 1908:195.

Endemic. Oahu (type locality: Palolo).

This is a color form in which the tegmina are not bicolored but are entirely reddish (excepting the membrane).

The holotype is in the Hawaiian Sugar Planters' Association Experiment Station collection.

Nabis koelensis Blackburn (figs. 55, i; 63).
Nabis Koelensis Blackburn, 1888:352.
Reduviolus arrogans Kirkaldy, 1908:191. New synonym.
Reduviolus subrufus, in part by misidentification by Kirkaldy, 1902:156.
Reduviolus koelensis (Blackburn) Kirkaldy, 1909:63.

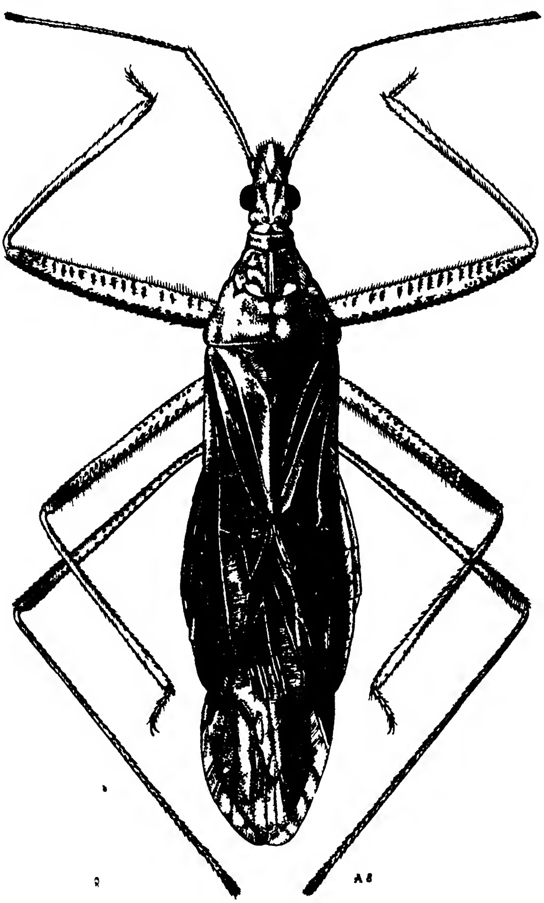


Figure 63—*Nabis koelensis* Blackburn. Drawn at the British Museum of Natural History by Smith from the holotype of *arrogans* (Kirkaldy).

Endemic. Molokai, Lanai (type locality: near Koele).

Hostplants: *Coprosma, Metrosideros* (?).

The unique female holotype, now in the Bishop Museum, was so badly damaged before it came to us that accurate identification is difficult. I have examined a good series of examples taken by Usinger on Lanai which I believe to be Blackburn's species and which may be topotypes.

I believe that this is a near relative of *oscillans* and that it may be only a geographical subspecies. Both this species and *oscillans* are variable in color and certain other features, but the male claspers appear to display a constant difference (fig. 55, i).

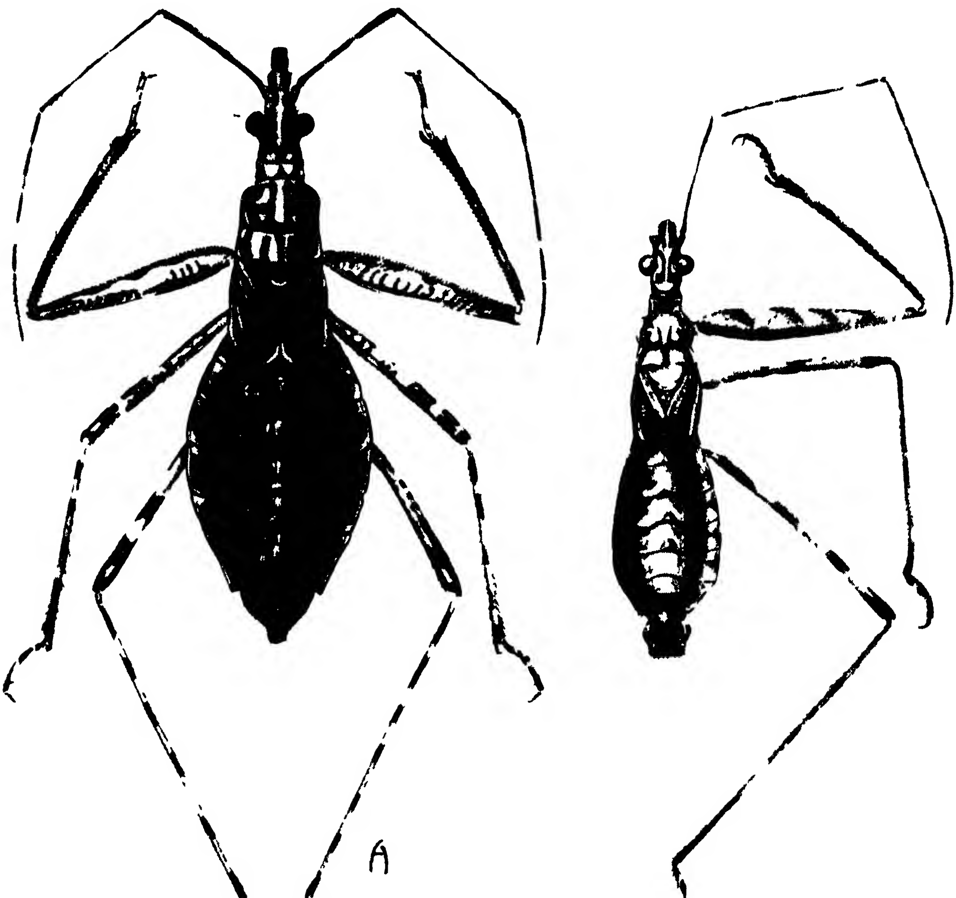


Figure 64—*Nabis lolupe* (Kirkaldy), female and male. (Abernathy drawings.)

The references of Kirkaldy to examples from Oahu are in error, for his specimens, at least in part, represent a new species. His figure (1909:63, fig. 6) was not made from an example of *koelensis*.

I have before me two examples collected by Usinger on Molokai which appear to be Kirkaldy's *arrogans*. These are identical with the Lanai specimens of *koelensis*, including the structure of the characteristic genital claspers, and, therefore, Kirkaldy's *arrogans* is reduced to synonymy. It will be advisable, however, to check his holotype.

Perkins (1912:728) thought that this might be a synonym of *subrufus*, but it is quite distinct. However, the species may be confused or mixed in some collections.

Nabis lolupe (Kirkaldy) (figs. 55, j, 1; 64).
Reduviolus lolupe Kirkaldy, 1908:193; 1909:68, fig. 9; 1910:549.

Endemic. Kauai (type locality: undetermined).

Hostplant: *Cyrtandra*.

Kirkaldy's unique female holotype, which is in the British Museum, apparently has no definite record attached to it, and he gave as the type locality "Kauai ? Molokai ?." I have examined two females and a male from Kauai which are believed to be this species. A pair of these is illustrated here in figure 64. The male was taken by Swezey at Kinana, August 2, 1935, one female was collected by Usinger at Kalalau Lookout, December 29, 1935, and the other female was taken by me in the northeast Alakai Swamp region, July 21, 1937. The male is a much more slender insect than the female, and it is paler. The annulations on the antennae and legs vary in intensity. The middle vein on the tegmina of the male is less well marked than on the female.

Nabis lusciosus White (figs. 56, a, b; 65).
Nabis (?) *lusciosus* White, 1877:112; 1878:366.
Reduviolus lusciosus (White) Kirkaldy, 1902:157, pl. 5, fig. 35 (fig. 34 is *curtipennis*); 1908:192; 1909:65.
Nesotyphlias lusciosus (White) Kirkaldy, 1907:155.
Reduviolus monticola Kirkaldy, 1908:192. Synonymy by Kirkaldy, 1909:66.

Endemic. Oahu (no type locality given by White).

Hostplants: grasses, ferns, *Acacia koa, Metrosideros, Pipturus, Straussia.*

Of all the flightless species, this is the one most abundantly represented in collections. It is confined to Oahu, but there are several other species from Kauai, Molokai, Maui and Hawaii which are closely allied to it and which have been confused frequently with it. These species are closely and confusingly similar in the female sex. Some of them are undescribed. I have seen more than one species in this complex on Oahu, and Kirkaldy included more than one Oahu species under

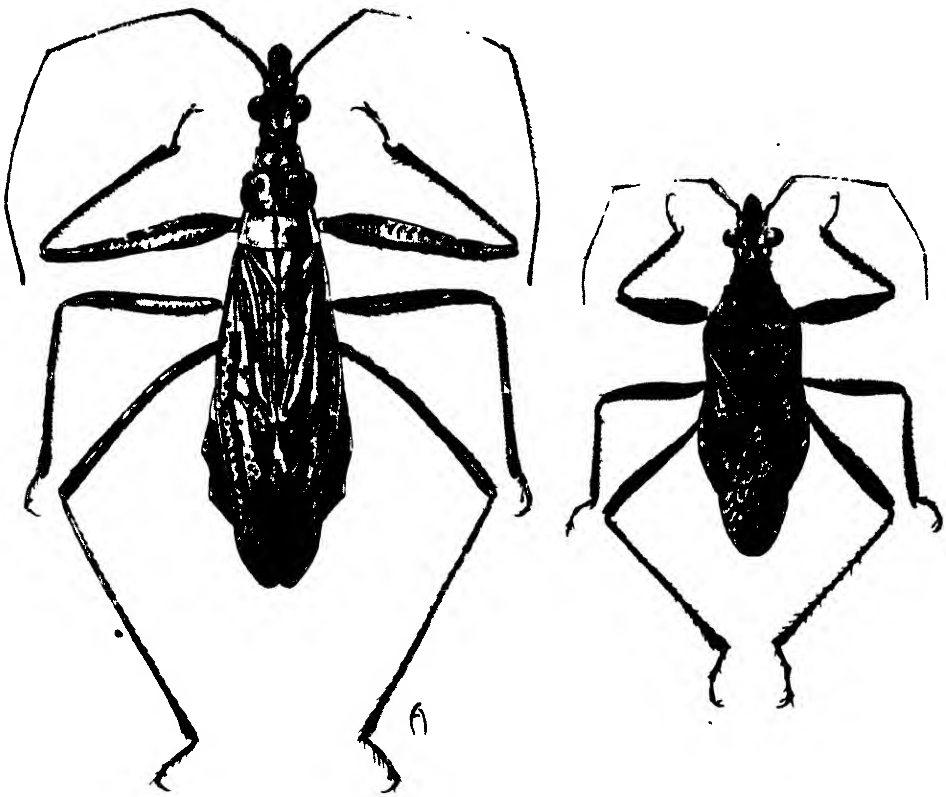


Figure 65—*Nabis lusciosus* White, left. *Nabis nubigenus* (Kirkaldy), right. (Abernathy drawings.)

this name in the material he studied. The records in literature contain numerous errors resulting from the misidentification of the species of this group.

Although the hind wings are obsolescent (about 0.5 mm. long) and the tegmina are distinctly modified, the latter organs extend to the apex of the abdomen and are not abbreviated as they are on many of the flightless forms.

Kirkaldy saw the holotype in the Perth Museum.

This species mainly frequents grass and low herbage and I have seen it preying upon the nymphs of the common, terrestrial native cricket *Paratrigonidium pacificum* Scudder on Mount Tantalus, Honolulu.

Nabis morai (Kirkaldy) (figs. 56, f; 59).

Reduviolus morai Kirkaldy, 1902:155, pl. 5, fig. 39 (fig. 39a is not of this species); 1908:191; 1909:62; 1910:547.

Endemic. Kauai (type locality: high plateau, 4,000 feet).

This species, although it is restricted to Kauai, has been confused with other species, and it has been recorded in literature erroneously as occurring on other islands. Kirkaldy listed it originally from Kauai, Oahu, Molokai, Lanai and Maui without designating a type locality. Later (1908:191) he gave the type locality as Kauai. I have delimited it further, as noted above, from data from cotypes in the Bishop Museum. The holotype is in the British Museum.

It is a dark form with numerous, large, shallow, dark punctures on the tegmina. It approaches *nubigenus* (with which it was confused by Kirkaldy) although it is not quite so short and stout as that species.

Nabis nesiotes (Kirkaldy).
Reduviolus nesiotes Kirkaldy, 1909:65, fig. 12.

Endemic. "Hawaiian Isles (? locality)."

This was described from "fragments of a single female, and . . . described . . . only because it appears to me not to be conspecific with any other form; and to be worthy of record on account of the wing reduction." (Kirkaldy, 1909:65.)

The type is in the British Museum. I do not know how it can be recognized from Kirkaldy's notes and lack of an insular record. He said (1909:65), "This has the general appearance of a short-winged *blackburni,* but the female abdomen is more like that of *subrufus*. It is larger and darker than *blackburni*. . . . In brachypterous *blackburni* the wing-venation is nearly the same as that of the normal form, except that it is shortened, but in *nesiotes,* the wing-venation is much reduced." Mr. China has kindly placed it in the key. The broken type is in too poor a condition to draw, according to the artist.

Nabis nubicola (Kirkaldy) (figs. 57, b; 59).
Reduviolus nubicola Kirkaldy, 1909:67.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Mr. China has examined the holotype in the British Museum for me and has sent the following note: "The unique type is a male. It is not darker or more reddish brown than *N. lusciosus*. It is a very striking species with long pointed membrane on the relatively short (brachypterous) elytron. The male clasper is very striking, being large and truncated at apex instead of pointed as in *N. lusciosus* and many other species." Obviously, there is some confusion here. Kirkaldy's original description reads as follows: "Of this I have not seen a male; the female differs from *lusciosus* by the lateral margins of the pronotum being more divergent behind, and the fore lobe more convex. The membrane is shorter and more divergent interoapically, lateral margins straight or slightly emarginate. The basal segment of the antennae has faint fuscous annulations. Length, 8 mill. Hab. Maui, Haleakala (5000 ft., Perkins)." Perhaps the words "male" and "female" in the description were transposed by error.

There is a pair of specimens in the Bishop Museum's share of the *Fauna Hawaiiensis* material under this name, and they come from the type locality. They were apparently determined by Perkins, but they represent a new species.

Nabis nubigenus (Kirkaldy) (figs. 56, g–i; 65).

Reduviolus nubigenus Kirkaldy, 1908:191; 1909:63, pl. 1, fig. 15; 1910:547. (Kirkaldy, 1902, pl. 5, fig. 39a applies to this, not *morai.*)

Endemic. Molokai, Maui, Lanai (type locality: Haalelepakai).

Hostplant: *Metrosideros.*

I have examined cotypes from Maui, Molokai and Lanai, in addition to a series of specimens taken in more recent years on Maui and Lanai. Kirkaldy thought that it also came from Oahu, but when he described the species as distinct from *morai,* with which he had confused it originally, he stated that he was not sure of the Oahu record. No specimens of such a species from Oahu have come to my attention, and I believe that the record had best be dropped, unless conclusive data to the contrary are assembled.

There are slight differences in the form of the male genital claspers among the specimens from Molokai, Lanai and Maui. I have figured one from each island. There is only one example of the Molokai form (a Kirkaldy cotype) available to me. As illustrated, the clasper of the Molokai specimen has the more divergent shape. Perhaps a series of examples would show more intergradation. The Molokai and Maui specimens might possibly be considered forms of the species, but on the basis of present knowledge, I believe that they are too closely allied to be considered species.

This is our shortest and stoutest volant *Nabis,* and it is a distinctive form. The tegmina have a purplish or reddish tinge, and, like *morai,* they have many conspicuous, shallow, dark punctures. Usinger (1936:218) noted that the series of specimens collected by him on Lanai "exhibits striking sexual dimorphism, the males in every case having a ground color of mottled or spotted dark gray while the females are decidedly lighter with a ferrugineous ground color." His specimens (in the collection for more than 10 years) now do not show such striking differences in color, and the sexes are more nearly uniform in coloration. The series of examples from Maui have indications which show that in life they had a similar dichromatism.

Nabis oscillans Blackburn (figs. 56, j; 66).

Nabis oscillans Blackburn, 1888:352.

Endemic. Hawaii (type locality: Mauna Loa, 4,000 feet).

Hostplants: *Metrosideros* (preferred host), *Santalum* (sandalwood).

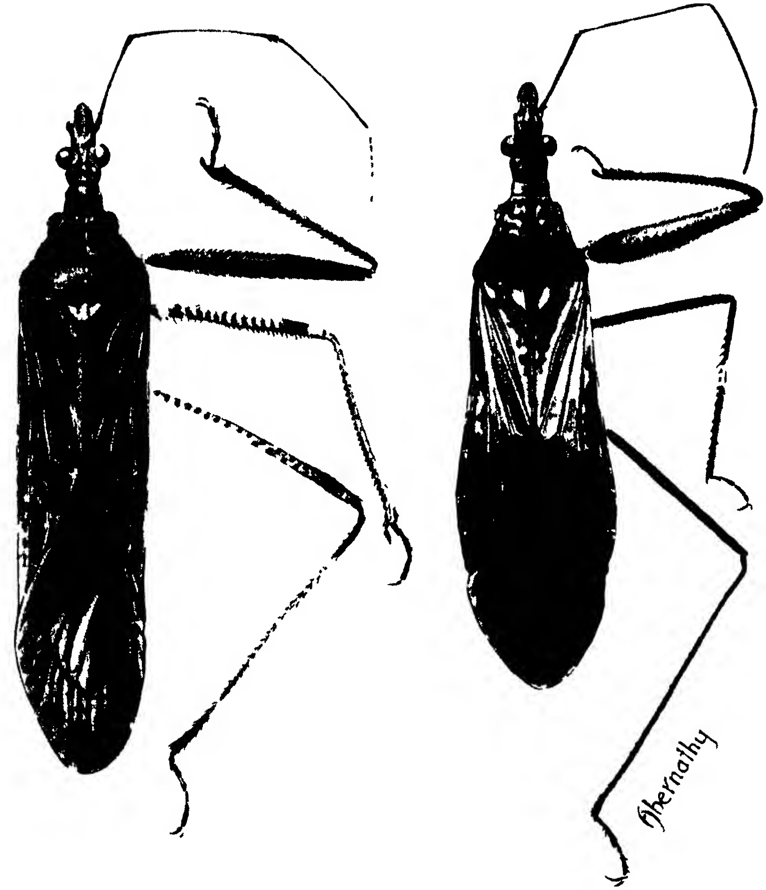


Figure 66—*Nabis oscillans* Blackburn, left. *Nabis sharpianus* (Kirkaldy), right. (Abernathy drawings.)

Blackburn's type and paratype are now in the Bishop Museum. Although the holotype is not in perfect condition, it is not in such bad condition as one would expect from reading Kirkaldy's remark in his 1902 report.

Kirkaldy (1902:156) placed this species as a synonym of *subrufus*; in 1908 (p. 191) he listed it separately; in 1909 (p. 64) he again placed it under *subrufus*; and in 1910 (p. 547) he again separated it, stating that he was not sure that he knew the species.

This species is an ally of *subrufus*, which it closely resembles. However, I feel that it is a distinct Hawaii representative of the Oahu *subrufus*. The claspers are different and none of a long series of specimens examined has annulate tibiae.

Mr. China informs me that there are no specimens under the name *oscillans* in the British Museum.

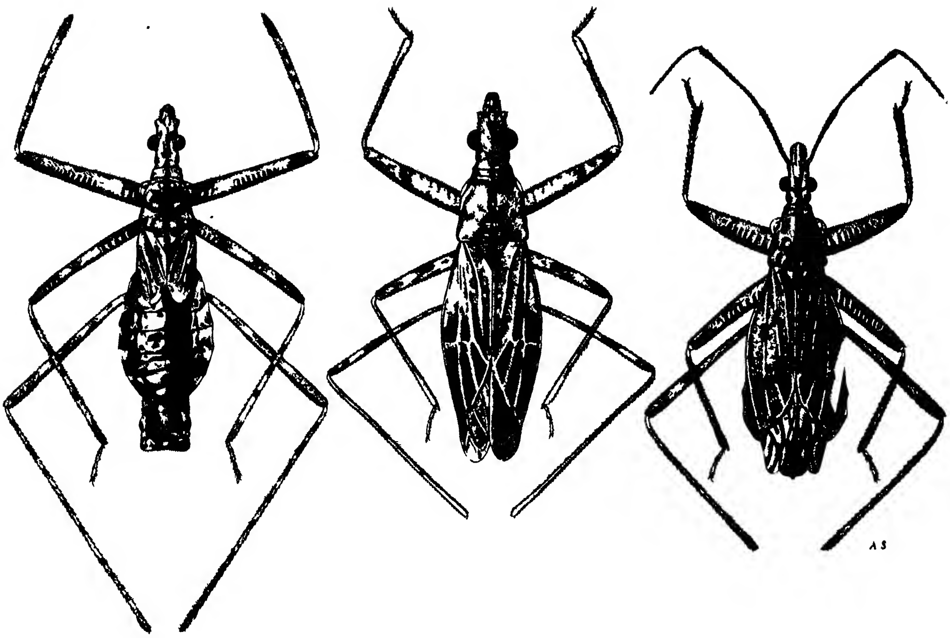


Figure 67—*Nabis paludicola* (Kirkaldy), holotype male, left. *Nabis pele* (Kirkaldy), holotype male, middle. *Nabis procellaris* (Kirkaldy), holotype female, right. (Drawn at the British Museum of Natural History by Smith.)

Nabis paludicola (Kirkaldy) (figs. 57, c; 67).
Reduviolus paludicola Kirkaldy, 1908:193; 1909:68; 1910:549.

Endemic. Molokai (type locality: 4,000 feet).

Little is known about this species. What may be Kirkaldy's female cotype is in the *Fauna Hawaiiensis* collection at the Bishop Museum. The specimen is in a fragmentary condition. The entire body anterior to the scutellum is wanting, and only the middle pair of legs remains. Thus, the most important features mentioned by Kirkaldy are missing from our example. However, the male holotype, which is in the British Museum, is figured here, and the illustrations display the distinctive features of this very short-winged, remarkable species.

Nabis pele (Kirkaldy) (figs. 56, c; 67).
Reduviolus pele Kirkaldy, 1909:67.

Endemic. Hawaii (type locality: Olaa).

Hostplants: *Cibotium* fern, *Metrosideros* (host of holotype).

There is a single male example in the Bishop Museum's *Fauna Hawaiiensis* material. It resembles closely a small *lusciosus*. The holotype, illustrated here, is in the British Museum. Mr. China says that the holotype bears a red type label "*konanus* Kirk." and also a label written by Perkins, "*R. pele*. Type wrongly labeled *konanus* by Kirkaldy."

Nabis procellaris (Kirkaldy) (figs. 56, d; 67).
Reduviolus procellaris Kirkaldy, 1908:193; 1909:67; 1910:548.

Endemic. Molokai (type locality: 4,500 feet).
Hostplant: *Freycinetia.*

This belongs to the *lusciosus* complex and resembles *lusciosus.* The male clasper with its peculiar, forward-projecting tooth on the lower margin is conspicuously different from that of *lusciosus,* as the illustrations show.

The female holotype is in the British Museum, and an illustration of it is included here. I have before me one male and two females from Kainalu, Molokai. The cells of the corium and the membrane are obviously shorter than those of *silvicola* which may easily be confused with this species in the female sex, at least.

Kirkaldy described this as a new species in 1908. In his 1909 paper, he apparently overlooked the fact that he had already described the species, for he described it as new again. In 1908 he stated that his type was a female, but in 1909 he considered it to be a male. China writes of the type in the British Museum that it "is a female, probably a brachypterous form of *N. lusciosus* B. White. Very similar indeed to *N. nesiotes* Kirk."

Nabis rubritinctus Blackburn (figs. 56, k; 62).
Nabis rubritinctus Blackburn, 1888:351.
Milu (?) *rubritinctus* (Blackburn) Kirkaldy, 1908:195.
Reduviolus rubritinctus (Blackburn) Kirkaldy, 1909:65.
Reduviolus (subgenus *Milu*) *rubritinctus* (Blackburn) Kirkaldy, 1910:549.
Reduviolus subrufus variety *melemele* Kirkaldy, 1909:64. New synonym.

Endemic. Maui (type locality).
Hostplants: *Acacia koa, Coprosma.*

This species has been known only from the unique type which is now in the Bishop Museum. It was damaged by insect pests before Perkins obtained it from the Blackburn collection, but it is in good enough condition to be recognizable, for the damage has been confined to the legs and antennae of the left side, the right wing and tegmen and the basal part of the abdominal venter. In Kirkaldy's 1902 paper (p. 93) he stated that Blackburn had loaned him the type for examination, but in 1910:549, he said that he had not seen it.

Blackburn (1888:352) said that "A single male of this handsome insect occurred on Maui, but I regret to find that I have no record of the exact circumstance of its capture." He misidentified the type as a male; it is a female. During this study, I have located two examples of this species in the Bishop Museum collections—one, a male from Hana, the other, a female from Kipahulu—and a pair in the Hawaiian Sugar Planters' Association Experiment Station collection from Olinda (all East Maui localities). The female from Kipahulu is colored as is the female holotype, with the posterior tegminal veins reddish. The male from Hana, however, has the entire tegmina red. The Olinda female lacks the reddish coloring.

The first antennal segment is heavier than the second, but it is not developed as in *kerasphoros* as Kirkaldy assumed it was.

This species bears a great resemblance to *sharpianus* from Kauai, to which I feel it is related.

I had placed Kirkaldy's variety *melemele* of *subrufus* as a synonym of this species on the basis of literature alone, but the type of *melemele* was checked by Mr. China at the British Museum. He found that it ran to this species in my key.

Mr. China sends information that specimens in Kirkaldy's series under this name at the British Museum are *kerasphoros.*

Nabis sharpianus (Kirkaldy) (fig. 66).

Reduviolus sharpianus Kirkaldy, 1902:156, pl. 5, fig. 36; 1908:191; 1909:64.

Endemic. Kauai (type locality: high plateau, 4,000 feet).

This is the brightest colored, most showy of the Hawaiian species. Its striking color pattern is characteristic. The tegmina are yellow as far back as the apex of the clavus, thence red. This pattern is duplicated in *kerasphoros,* but it is not as bright in that species.

I have never seen a male of this handsome insect, and Kirkaldy reported the same results from the series he examined. The holotype is in the British Museum.

Nabis silvestris (Kirkaldy) (figs. 56, n, o; 68).

Reduviolus silvestris Kirkaldy, 1908:194; 1909:67; 1910:459.

Endemic. Kauai (type locality: 4,000 feet).

Hostplants: *Acacia koa, Alyxia, Cibotium.*

This species is a Kauai representative of the Oahuan *lusciosus,* to which it is closely allied. It is smaller than typical *lusciosus,* and the male claspers are different, as the illustrations will show. Kirkaldy said that the tegmina are much shorter than on *lusciosus* and do not quite reach the apex of the abdomen. This statement appears to be true only for gravid females with distended abdomens. The series of specimens I consider to be this species includes both males and females. In all of these the tegmina exceed the abdomen except in one female whose abdomen is inflated. I have not seen the type, which is in the British Museum.

Nabis silvicola (Kirkaldy) (fig. 68).

Reduviolus silvicola Kirkaldy, 1908:192; 1909:66; 1910:548.

Endemic. Molokai (type locality not designated further).

Hostplant: *Freycinetia.*

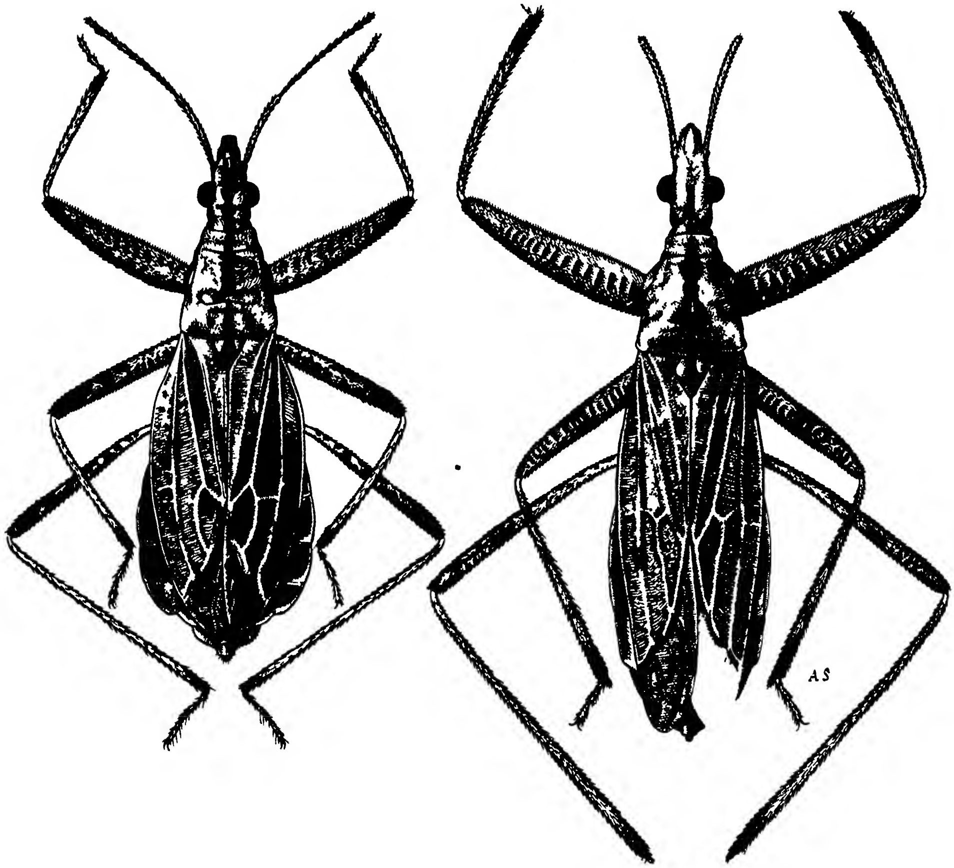


Figure 68—*Nabis silvestris* (Kirkaldy), holotype female, left. *Nabis silvicola* (Kirkaldy), holotype female, right. (Drawn at the British Museum of Natural History by Smith.)

The female holotype of this species is in the British Museum. Kirkaldy's original description "Scarcely to be distinguished from *lusciosus,* but the membranal venation is different and the ocelli more distinct. Length female 10½ mill." is worthless. There is considerable variation in the membranal venation and development of the ocelli in *lusciosus.* In 1909 (p. 66) he stated that "This is doubtfully valid, only a single female being known, but it is more elongate than *lusciosus,* and the pronotum seems proportionately longer, especially the median lobe." There are four females before me which I believe are this species. Two of them were taken by Perkins at 3,000 feet, November, 1902; one by A. F. Judd at McVeigh's, 3,500 feet, July 28, 1925; and the other by E. H. Bryan, Jr., at Kainalu, 2,000–3,000 feet, July 26, 1927, from *Freycinetia.* Although there is some variation in the length of the apical cells of the corium and the length of the membrane, all of these examples have these parts distinctly longer than those of *procellaris.* The illustrations show

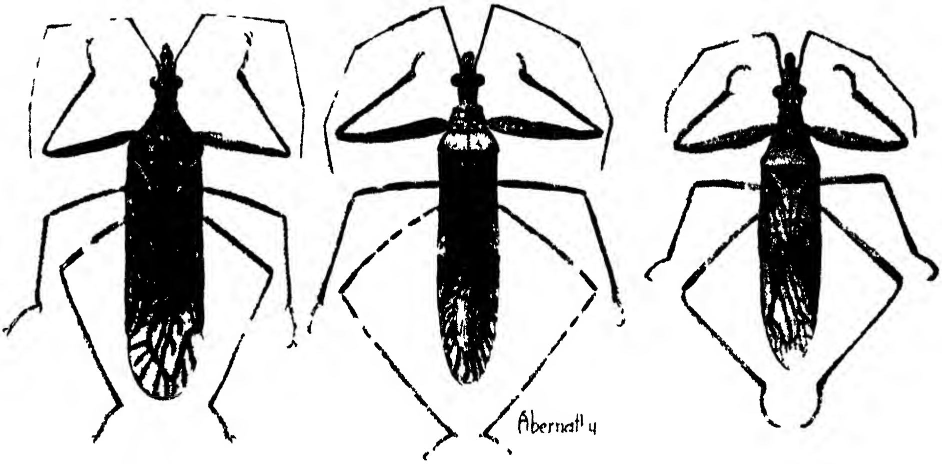


Figure 69—*Nabis truculentus* (Kirkaldy), left. *Nabis subrufus* White, middle. *Nabis tarai* (Kirkaldy), right. (Abernathy drawings.)

these characters plainly. Judging from the small series at hand, *silvicola* is a somewhat larger species than *procellaris*. When the male of *silvicola* is discovered, it may be found to display some excellent differential characters.

Nabis subrufus White (figs. 56, 1; 69).

Nabis subrufus White, 1877:112; 1878:366.

Reduviolus subrufus (White) Kirkaldy, 1902:156, pl. 5, figs. 37, 37a (fig. 38 does not apply to this species); 1908:191; 1909:64; 1910:547.

Endemic. Oahu (exact type locality undetermined).

Hostplants: *Metrosideros, Cyrtandra* (accidental ?).

Much confusion exists in literature regarding this species, and Kirkaldy included several forms from several islands under its name. Typical *subrufus* is an Oahu insect whose tibiae are annulate and whose male genital claspers are formed as in the accompanying illustration. The coloration varies considerably. Most of the specimens I have examined have the rings on the tibiae so distinct that I can see them without the aid of magnification. It is one of our commonest species.

Nabis tarai (Kirkaldy) (figs. 56, m; 69).

Reduviolus tarai Kirkaldy, 1902:154; 1908:191; 1909:61.

Reduviolus kaonohiula Kirkaldy, 1908:192 (the unique female type is from Hawaii, and is now in the British Museum); 1909:62, in synonymy; 1910:548.

Reduviolus mantivagus Kirkaldy, 1908:192.

Reduviolus tarai variety *montivagus* (Kirkaldy) Kirkaldy, 1909:62; 1910:548. New synonym.

Endemic. Kauai, Oahu, Molokai, Lanai (type locality), Maui, Hawaii.

Hostplants: *Styphelia* (*Cyathodes*), accidentally on other plants such as *Acacia koa*.

Among the native species, this species shares with *blackburni* the distinction of being widespread over the islands. It is somewhat variable, not only in color, but also in slight differences in the male genital claspers. However, these differences are not limited in kind to any one island or locality, but variations which occur at opposite ends of the main archipelago also occur in the same locality. The species resembles *blackburni,* but in the typical form it is decidedly reddish. Considerable fading in color takes place after death. The male claspers have a conspicuous notch in the ventral margin which is distinctive.

The male holotype is in the British Museum. Mr. China says that the unique female holotype of *kaonohiula* is similar to the type of *tarai* but is slightly more robust. Mr. China also notes that the specimen labeled as type of *montivagus* in the British Museum is not that species, but it appears to be probably a male *sharpianus*. A note on it by Perkins states that it is not *montivagus* nor *tarai* and that the type should be a female. A mixup of labels must have occurred. The type of *montivagus* is lost.

Nabis truculentus (Kirkaldy) (figs. 56, e; 69).

Reduviolus truculentus Kirkaldy, 1908:191; 1909:63, fig. 13; 1910:547; (1902: *156, part of subrufus,* and *pl. 5, fig. 38*).

Endemic. Oahu (type locality: Mount Tantalus region ["Honolulu Mountains"]).

Hostplant: *Pipturus* ("mamake").

This is a striking species because of its color pattern, as the illustration demonstrates. It can be distinguished from all other species at a glance. The holotype is in the British Museum; I have examined cotypes at the Bishop Museum.

Family CIMICIDAE (Latreille, 1804) Samouelle, 1819

The Bedbugs

Our single representative of this family may easily be distinguished from all other Hawaiian Heteroptera by the following set of characters: nocturnal, temporary ectoparasitic on man; body greatly flattened, coarsely setose throughout, rotund in lateral outline; flightless, hind wings absent, hemelytra reduced to small flaps; head retracted up to eyes in the shield-like pronotum, ocelli absent, antennae four-segmented, rostrum three-segmented, not surpassing fore coxae; tarsi three-segmented, claws without arolia.

This is a small family of bloodsuckers whose species are included in only a few genera. In addition to the species attacking man, others feed upon bats and others on birds. Some species are pests of pigeons and some cause serious trouble to poultry. It would be most unfortunate if additional species were imported to these islands.

Kirkaldy used this family name for the Pentatomidae and replaced it with Clinocoridae, but his action was caused by an error in the fixation of the genotype.

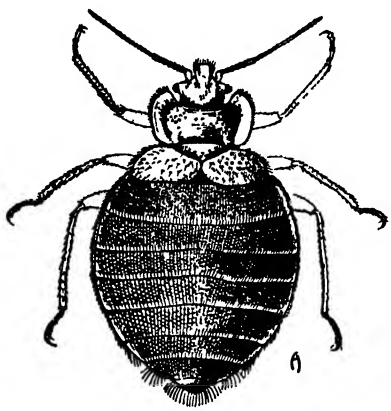


Figure 70—*Cimex lectularius* Linnaeus, the bedbug. (Abernathy drawing.)

Genus **CIMEX** Linnaeus, 1758:441

Cimex lectularius Linnaeus (fig. 70).

Cimex lectularius Linnaeus, 1758:441. Genotype. Fixed by Opinion 81 (1924) International Commission of Zoological Nomenclature.

Clinocoris lectularius (Linnaeus) of various authors.

Acanthia lectularia (Linnaeus), White, 1878:373.

Klinophilos lectularius (Linnaeus) Kirkaldy, 1899:219.

The bedbug (Hawaiian name: "uku-lio").

Evidently distributed throughout the islands.

Immigrant. Cosmopolitan. Established in Hawaii at an early date after the discovery of the archipelago by Captain Cook. Evidently first recorded from Hawaii in entomological literature by White (1878:373) as *Acanthia lectularia.*

There is little information regarding this pest in Hawaiian literature, but, in places, it is extremely abundant. It has increased with amazing rapidity since the beginning of World War II and has become more widespread than ever before. Fortunately, most cleanly householders do not know this pest. Because of the large numbers of troops and war workers stationed in the islands and the erection of

hundreds of barracks, one of the greatest bedbug exterminating problems in the history of the United States armed forces was said to have confronted medical officers here.

We have had no records of the tropical bedbug, *Cimex hemipterus* Fabricius, from Hawaii, although we might expect to find it here, for it is widespread in the tropics. It may be distinguished by its much less transverse prothorax (only about one-third or less broader than the breadth of the head across the eyes, or only slightly longer than the median line of the head and pronotum combined, whereas on *Cimex lectularius* the prothorax is nearly twice as broad as long and much broader than the median length of the head and pronotum combined), and by its darker color.

Bedbugs have pestered man for ages—even the ancient Greeks mentioned them. In spite of man's continued war against them, they are still pests of major importance. They are secretive, gregarious creatures which hide in cracks, crevices and crannies during the day but emerge at night to conduct nocturnal forays in search of blood meals from sleeping men. An individual female bug may lay from about 200 to 500 eggs in small batches over a period of a few weeks to several months. The eggs may hatch in about 10 days or less; the nymphs molt five times and may reach adulthood in six weeks. They can go long periods of time without food. They give off a characteristic musky odor which may be pronounced in rooms where they are abundant.

In spite of various reports, it apparently has never been proved that bedbugs are normal vectors of any human disease. Under experimental conditions it has been shown that bedbugs may transmit a few diseases, but they are not regarded as natural vectors.

When feeding undisturbed, a bedbug takes about five minutes or more to engorge fully. Individual hosts react differently to the bites. Some persons may be unusually sensitive and may become rather severely poisoned by the salivary secretions of the bug. Itchy welts, which may become secondarily infected through scratching, may result from their feeding. Much irritation and loss of sleep may accompany attacks. Continued, heavy feeding may result in various complications such as irritability, eye and heart disturbances, headache, anemia and nervousness.

Control. Inasmuch as bedbugs are so secretive in habit, they are frequently difficult to control. The best insecticide ever discovered for their control is DDT. A 5 percent solution sprayed over surfaces in infested areas will give excellent control for six or more months. Some older methods of control are as follows: In rooms and buildings that can be closed for fumigation, excellent control may be obtained by cyanide or methyl bromide fumigation. If these fumigants are not available, the burning of three pounds of sulfur per 1,000 cubic feet of space may be used. However, sulfur will tarnish metal and bleach fabrics and colored goods and may not be safe to use. In small rooms fumigation by the use of paradichlorobenzene crystals may be possible. In roughly constructed buildings such as temporary barracks, kerosene may be applied to the entire structure by the use of a long hose from a pump and a good spray nozzle. The kerosene may be forced

easily into all cracks and interspaces where the bugs may be hiding. (The moveable contents of such barracks must be removed to a fumigating vault, however.) Similar use may be made of the commercial sprays of pyrethrum in oil which may be applied with a hand sprayer. Various dusts such as pyrethrum, rotenone and sodium fluoride are useful if they can be brought in contact with the bugs.

Family **ANTHOCORIDAE** (Amyot and Serville) Dallas, 1852

Flower Bugs

A beneficial, predaceous group of small bugs with the following characters in common: head prolonged anteriorly; rostrum three-segmented, held away from lower surface of the head as in certain Reduviidae and Nabidae; antennae four-segmented; a pair of ocelli present or absent; hemelytra with cuneus and embolium well formed, separated by a distinct fracture; tarsi three-segmented, claws without arolia. The male genitalia are peculiar, and are closely similar to those of the cimicids; there is a single asymmetrical genital organ.

Occasionally, when passing through shrubbery on a hot day, one may be bitten by one or more of our immigrant species. These bugs feed on thrips, psocids and other small insects.

In addition to the genera and species listed hereinafter, I have examined undescribed new endemic forms—some of them brachypterous—and unidentified immigrant species.

The characters used to define the subfamilies and genera are not always as easily ascertained as we should like them to be. Therefore, two keys are given here, the first uses the accepted characters for the delineation of the subfamilies, and following that I have included a single key to all the genera of the family now recorded from the archipelago.

Key to the Subfamilies of Anthocoridae

1. Hind wings without a hamus in cell (our species are yellow or brownish-yellow with no extensive dark coloring excepting *Poronotellus*) .... **Dufouriellinae.**

   Hind wings with a hamus in cell (all of our species with extensive dark coloring except *Lilia,* which has scutellum and most of pronotum, at least, dark) 2

2. Hairs on last two antennal segments very long, much longer than diameter of a segment (at least twice as great, up to four to six times as great in some forms) ...... **Lyctocorinae.**

   Hairs on last two antennal segments hardly longer than diameter of a segment .... **Anthocorinae.**

Key to the Genera of Hawaiian Anthocoridae

1. Hairs on last two antennal segments hardly longer than diameter of a segment........................**Orius** Wolff.
   Hairs on last two antennal segments very long, much longer than diameter of a segment (at least twice as great, up to four to six times as great in some forms)............. 2

2(1). Ostiolar orifices curved cephalad......................... 3
   Ostiolar orifices curved caudad........................... 4

3(2). Dorsal end of ostiolar orifice remote from anterior metapleural margin; fore femora armed with a small tooth near distal third; side margins of pronotum distinctly explanate; dorsum with at most only a few hairs, nearly bare ....**Lilia** White.
   Dorsal end of ostiolar orifice extending nearly to anterodorsal corner of metapleura; fore femora unarmed; side margins of pronotum not explanate; dorsum conspicuously hirsute..........................**Xylocoris** Dufour.

4(2). Rostrum short, not reaching fore coxae: fore femora multispinulose beneath, fore tibiae arcuate...**Physopleurella** Reuter.
   Rostrum reaching or surpassing fore coxae; fore legs without such a combination of characters.................. 5

5(4). Our species conspicuously, almost entirely, yellow...**Cardiastethus** Fieber.
   Predominantly brown or black species.................... 6

6(5). Head much broader across eyes than length of second antennal segment ....**Poronotellus** Kirkaldy.
   Head hardly as wide across eyes as length of second antennal segment 7

7(6). Hemelytra not punctate; veins of membrane obscure or obsolete ....**Lasiochilus** Reuter.
   Hemelytra "minutely and closely irregularly punctate"; veins of membrane hyaline..............**Lyctocoris** Hahn.

Subfamily LYCTOCORINAE (Reuter, 1884)

This subfamily contains four of the eight genera and about three-fourths of the species found in Hawaii. The long hairs on the two apical antennal segments together with the presence of a hamus in the cell of the hind wings serve to distinguish this group from the other two.

Key to the Genera of Lyctocorinae Found in Hawaii

1. Sides of pronotum margined, explanate, not setose; fore femora with a tooth beneath at about distal one-fourth...**Lilia** White.
   Sides of pronotum not or narrowly or incompletely explanate, always distinctly setose; fore femora not so armed... 2

2(1). Head about twice as long in front of eyes as length of an eye .... **Lasiochilus** Reuter.
Head, measured from above, not conspicuously longer in front of eyes than length of an eye 4

4(3). Metapleura with the channels of orifices strongly developed, sub-?-mark shaped, strongly curved forward to dorso-cephalic corner of each metapleuron ...... **Xylocoris** Dufour.
Metapleural channels of orifices not so formed, curved caudad or otherwise different .... **Lyctocoris** Hahn.

Genus **LILIA** White, 1879:147

This genus is known only from Hawaii. Its armed fore femora and its explanate, bare, lateral pronotal margins serve to distinguish it from its congeners. "It has, in some respects, more the aspect, at first sight, of a Lygaeid than an Anthocorid due perhaps to the rows of punctures on the elytra." (White, 1879:147.)

Lilia dilecta White (fig. 71).
Lilia dilecta White, 1879:147.

Endemic. Kauai, Maui (type locality: 5,000 feet).

Hostplants: *Acacia koa* (beneath bark), *Cyanea* (in rotting stem), *Straussia.*

This is a predominantly yellowish-brown species with the pronotal disc and scutellum dark. It is one of our larger species, for it attains a length of about 3.5 mm. Kirkaldy (1904:179) says that the type has been lost.

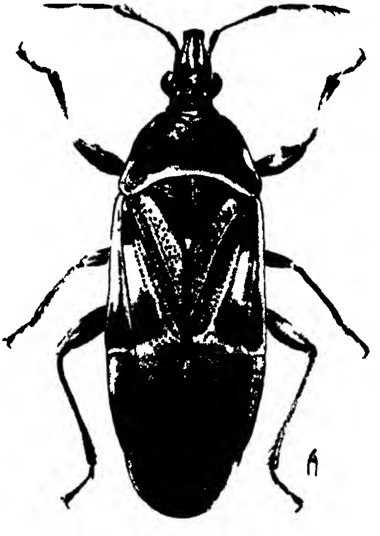


Figure 71—*Lilia dilecta* White. (Abernathy drawing.)

Genus **LASIOCHILUS** Reuter, 1871

This widespread genus has five Hawaiian species assigned to it, and it is thus the only genus of Anthocoridae which contains more than a single recorded species in Hawaii. Its species are comparatively large, up to 4 mm. in length, and are somber, dark brown or fuscous in color.

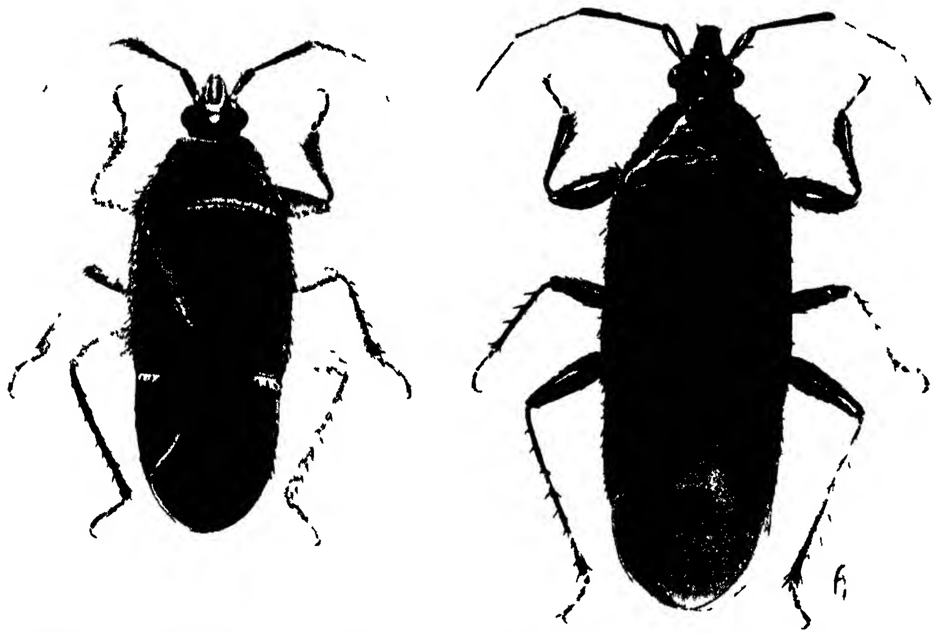


Figure 72—*Lasiochilus decolor* (White), left. *Lasiochilus denigratus* (White), right. (Drawn to same scale by Abernathy.)

Key to the Hawaiian Species of Lasiochilus

(I have not examined specimens of all of the following species, and have been unable to see authentically identified specimens of certain others. I believe that there are a number of new species to be described in this group. The key was checked by Mr. China with the British Museum material.)

1. Hemelytral membrane with "three small basal spots, and a large one apically; length 3⅛ mill."...**nubigenus** Kirkaldy.
   Membrane not maculate 2

2(1). Hemelytra distinctly maculate "clavus with a broad line near the base (by the scutellum), the clavo-corial suture, [a spot on middle of corium between embolium, claval suture and cuneal fracture], and a spot on the cuneus, yellowish-brown"; about 4 mm. long..........**montivagus** Kirkaldy.
   Hemelytra not so maculate.............................. 3

3(2). Scutellum with almost basal one-half shiny, remainder dull; about 3.5 mm. long..................**denigratus** (White).
Scutellum almost or entirely dull, at most shiny at extreme base.................**silvicola** Kirkaldy; **decolor** (White).

Lasiochilus decolor (White) (fig. 72).
Dilasia (?) *decolor* White, 1879:147.

Endemic. Oahu (type locality: Honolulu).
Hostplant: *Straussia.*
Kirkaldy (1904:179) says that the type has been lost. White's collection at Perth, Scotland, was examined by him. Mr. China informs me that the species is not represented in the British Museum.

Lasiochilus denigratus (White) (fig. 72).
Dilasia (?) *denigratus* White, 1879:146.

Endemic. Kauai, Oahu, Lanai, Maui, Hawaii (type locality: Mauna Kea, about 3,000 feet).
Hostplants: *Antidesma, Cibotium chamissoi, Coprosma,* dead tree-fern stem.
Kirkaldy (1904:179) says that the type has been lost.
The records applied to this species may refer to several species.

Lasiochilus montivagus Kirkaldy (fig. 73, a).
Lasiochilus montivagus Kirkaldy, 1908:197.

Endemic. Lanai (type locality: Koele Mountains), Hawaii.
Hostplant: *Cheirodendron.*
The type is in the British Museum and is figured here.

Lasiochilus nubigenus Kirkaldy (fig. 73, b).
Lasiochilus nubigenus Kirkaldy, 1908:197.

Endemic. Maui (type locality: Mount Haleakala, 5,000 feet).
Our figure is from the type in the British Museum.

Lasiochilus silvicola Kirkaldy (fig. 73, c).
Lasiochilus silvicola Kirkaldy, 1908:196.

Endemic. Kauai (type locality: Kaholuamanu).
The type is in the British Museum and is figured here.

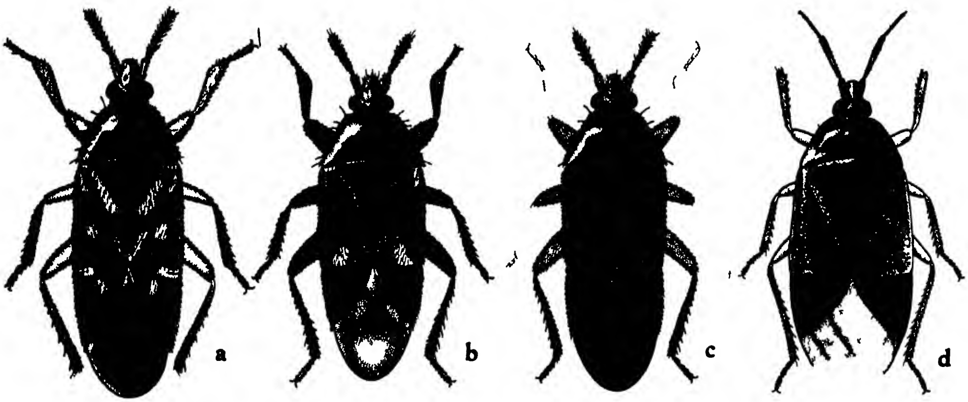


Figure 73—Holotypes of anthocorids: a, *Lasiochilus montivagus* Kirkaldy; b, *Lasiochilus nubigenus* Kirkaldy; c, *Lasiochilus silvicola* Kirkaldy; d, *Lyctocoris hawaiiensis* (Kirkaldy). (Drawn at the British Museum of Natural History by Smith)

Genus **LYCTOCORIS** Hahn, 1836

Nesidiocheilus Kirkaldy, 1902:127. New synonym.

Genotype: *Acanthia campestris* Fabricius, fixed by Kirkaldy, 1906.

Kirkaldy described *Nesidiocheilus* as a new endemic genus and compared it with *Lilia* from which he said it differed at least by its simple fore femora and that it most closely resembled *Lasiochilus* but had punctate hemelytra. This has long been a puzzle in our fauna, but Mr. China has examined Kirkaldy's type and finds that it is the same as *Lyctocoris*.

Lyctocoris hawaiiensis (Kirkaldy), new combination (fig. 73, d).

Nesidiocheilus hawaiiensis Kirkaldy, 1902:127.

Maui (type locality: Mount Haleakala, between 7,000 and 10,000 feet).

Immigrant (?). Mr. China tells me that the unique holotype (figured here) in the British Museum is "closely allied to *Lyctocoris campestris* F. and probably merely a form of this cosmopolitan species." It has never been collected since it was described, to my knowledge, and I feel that perhaps it should be removed from our list.

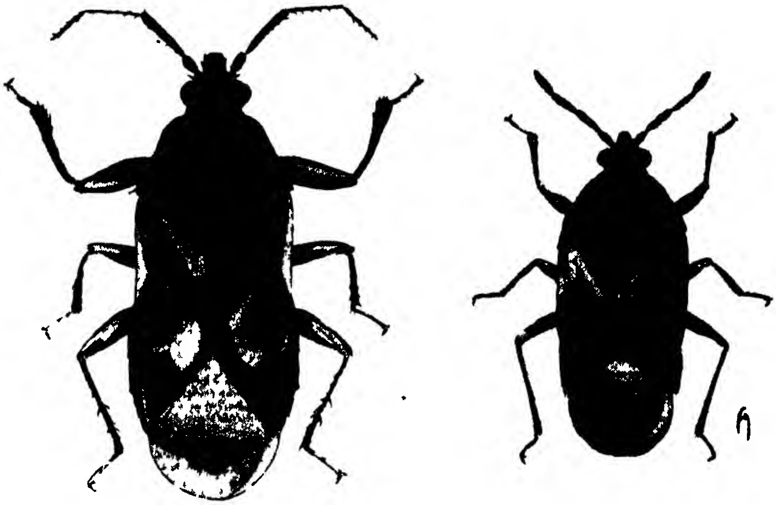


Figure 74—*Xylocoris discalis* (Van Duzee), left. *Orius persequens* (White), right. (Drawn to same scale by Abernathy.)

Genus **XYLOCORIS** Dufour, 1831

Genotype: *Xylocoris rufipennis* Dufour, the only species included by Dufour.

This widespread genus is represented in our fauna by one immigrant species. The long, strongly developed, anteriorly curved metapleural orifice together with the bicolored hemelytra will serve to distinguish this genus from its associates here.

Xylocoris discalis (Van Duzee) (fig. 74).
Scoloposcelis discalis Van Duzee, 1914:15.

Oahu.
Immigrant. A western North American species. It was first collected in the Territory at Honolulu in 1921 by S. Bickerton.
The membrane and most of the remainder of the hemelytra, excepting most of the area behind the fracture, is white or subhyaline.

Subfamily ANTHOCORINAE (Reuter, 1884)

The antennae are comparatively stouter with obviously shorter setae in this subfamily than in the Lyctocorinae. A single species occurs in Hawaii.

Genus ORIUS Wolff, 1811

Triphleps Fieber, 1860.
Genotype: *Salda nigra* Wolff, the only species included by Wolff.

Orius is a widespread genus of minute anthocorids. A number of beneficial, predaceous species belong here. The eggs of the corn ear worm (*Heliothis*) are preyed upon by a species of this genus in Australia and North America.

Orius persequens (White) (fig. 74).
Triphleps persequens White, 1877:111.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii, Nihoa, Midway, Kure, Wake.

Immigrant. Widespread in the Pacific. Described from the Territory (but no more specific type locality designated by White).

Kirkaldy (1910:121) recorded *T. pumilio* Champion from Oahu, but he apparently was in error.

According to Kirkaldy (1904:179), the type of *persequens* has been lost.

Hosts: common and widespread on many kinds of plants where it feeds upon aphids, hemipterous and homopterous nymphs and thrips. It has been observed feeding on small nymphs of Orsillini. At times it helps considerably in the control of various thrips. It is often abundant in flowers. I have seen numbers of dead specimens caught on the sticky surfaces of tobacco leaves infested with aleyrodids.

The eggs are inserted in plant tissue, and have been found in *Portulaca.* The nymphs are yellowish, and the nymphal period was reported by Swezey (1905:235) to be 14 days.

Subfamily DUFOURIELLINAE Van Duzee, 1916

The character used to separate this subfamily from the Lyctocorinae and Anthocorinae is a difficult one to see, for one hemelytron must be lifted or removed to examine the hind wing to note whether or not the cell lacks a hamus (a short spur vein projecting into the cell). However, two of the three immigrant species we have in Hawaii are distinguishable at a glance once they are known. Their antennae have long hairs and can only be confused with the Lyctocorinae. These two species are mostly pale yellowish or brownish-yellow and thus can only be confused, perhaps, with *Lilia dilecta,* but that species has the pronotum and scutellum largely dark and is nearly bare above, whereas these species have the pronotum and hemelytra conspicuously hirsute. The third species included herein, *Poronotellus sodalis,* cannot be so easily distinguished. It does, however, have the

hind margin of the pronotum deeply, concavely emarginate and the discs of the pronotum and of the scutellum have a distinct and comparatively deep transverse impression as do those of *Physopleurella* and *Cardiastethus*.

Key to the Genera of Dufouriellinae Found in Hawaii

1. Rostrum hardly as long as head, not reaching fore coxae; fore tibiae distinctly arcuate................**Physopleurella** Reuter.

   Rostrum longer than head, reaching or passing fore coxae; fore tibiae straight 2

2. Our species pale yellow; head only about as broad across eyes as length of second antennal segment.....**Cardiastethus** Fieber.

   Our species dark colored; head much broader across eyes than length of first antennal segment.........**Poronotellus** Kirkaldy.

Genus **PHYSOPLEURELLA** Reuter, 1885

Although our single immigrant species of this genus resembles *Cardiastethus,* it readily may be distinguished generically by its short rostrum, its slightly arcuate fore tibiae and by its stouter femora which are multi-spinulose beneath.

Physopleurella mundula (White) (fig. 75).
Cardiastethus mundulus White, 1877:111.

Kauai, Oahu, Molokai, Maui, Hawaii. (No specific type locality designated by White.)

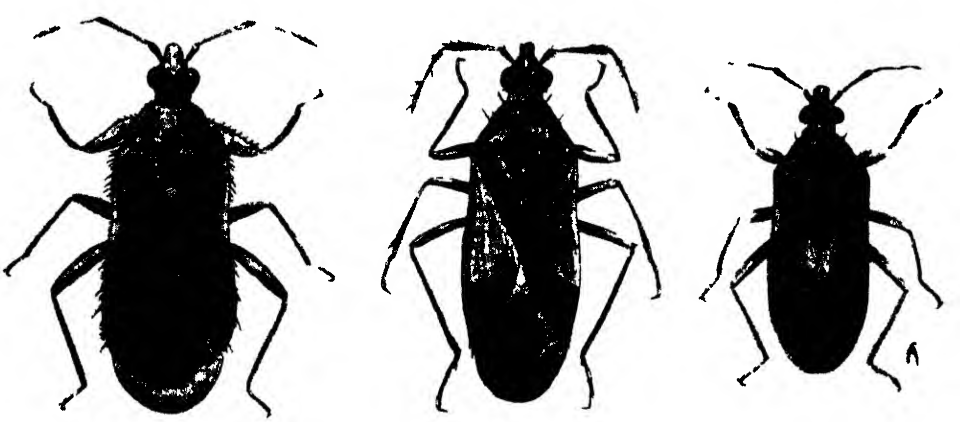


Figure 75—*Physopleurella mundula* (White), left. *Cardiastethus fulvescens* (Walker), middle. *Poronotellus sodalis* (White), right. (Abernathy drawings.)

Immigrant. Probably widespread in the Pacific. Usinger (1946:55) records it from Guam.

Swezey (1905:235–236, pl. 16, figs. 4–6) reported finding it feeding on aphids, psocids and young sugarcane leafhoppers. "The eggs are .6 mm. long, yellowish, with a raised collar or crown at anterior end, laid flat on a leaf, singly, in [a] secluded place. Some were found under the web or nest of Psocids on orange leaves. A few laid in confinement hatched in 4 to 5 days. The nymphs are reddish in color and of very lively habits, though keeping secluded generally."

White (1878:365) records Blackburn's field note as follows: "Not rare about the outside of roofs of houses." Perkins (1913:cc) found it ". . . especially common, sometimes occurring in countless numbers as in the cane-fields at Paauhau in 1903, hiding amongst the dead cane-leaves, where it preyed largely on Psocidae and small leaf-hoppers. On the leaves of growing trees or shrubs, such as crotons, oranges, mulberries, etc., the conspicuous red nymphs and mature bugs are often found beneath the webs made by the Psocidae, which feed on the black fungous growth that springs up on the excretions of various scale insects infesting these trees. One may find at such times a small flock of Psocids resting side by side with their enemy, beneath the covering made by the former."

I have found dead specimens caught on the sticky surfaces of tobacco leaves.

Genus **CARDIASTETHUS** Fieber, 1860

Genotype: *Cardiastethus luridellus* Fieber, fixed by Kirkaldy, 1906.

The rostrum extends onto the mesosternum, the fore femora are slender, hirsute but not spinulose beneath, and the fore tibiae are nearly straight throughout. Each of these characters differs from those of *Physopleurella*. The genus is widespread.

Cardiastethus fulvescens (Walker) (fig. 75).

Xylocoris fulvescens Walker, 1872:160.

Xylocoris fumipennis Walker, 1872:160. Synonymy by Distant, 1904:221.

Amphiareus fulvescens (Walker) Distant, 1904:220; 1906:4, fig. 3. Genotype of *Amphiareus*.

Kauai, Oahu.

Immigrant. Described from Ceylon; widespread in the Indo-Pacific area. First recorded from Hawaii by Usinger (1946:55) from specimens taken in Honolulu as early as 1910.

Genus **PORONOTELLUS** Kirkaldy, 1904:280

Poronotus Reuter, 1871.
Buchananiella Reuter, 1885.

This genus is also represented in Hawaii by a single immigrant species. Our species is somewhat similar in color pattern to that of our *Xylocoris,* but the two genera can be separated by a glance at the metapleura. On this genus the metapleural orifice curves backward to the middle of the hind margin of the metapleuron whereas it curves sinuously to the fore margin in *Xylocoris.*

Poronotellus sodalis (White) (fig. 75).
Cardiastethus sodalis White, 1878:372.
Buchananiella sodalis (White), of authors.

Kauai, Oahu, Maui. (Type locality not given by White, but probably Oahu.)

Immigrant. Known also from Guam; probably a widespread species.

Hostplants: *Acacia farnesiana, Acacia koa,* corn, sabal palmetto, sorghum, sugarcane, under dead *Eucalyptus* bark, among fungi on *Acacia koa.* I have found many dead specimens caught on the surface of tobacco leaves infested with "white fly."

Family **CRYPTOSTEMMATIDAE**

Dipsocoridae Dohrn, 1859.
Ceratocombidae (Reuter) Fieber, 1860.

Jumping Ground Bugs

This is a small family of peculiar bugs. A recently discovered, immigrant species is the only representative known to occur in Hawaii; it resembles somewhat certain anthocorids.

Small species less than 2 mm. long; ocelli situated close to eyes; antennae four-segmented, basal two segments stout, apical two slender, conspicuously hairy; rostrum long, three-segmented; hemelytra semimembranous, and of nearly similar texture throughout; tarsi three-segmented.

Genus **CERATOCOMBUS** Signoret, 1852

Genotype: *Anthocoris cleopatrata* Zetterstedt, the only species included by Signoret.

Subgenus **Xylonannus** Reuter, 1894

Ceratocombus hawaiiensis Usinger (fig. 76).

Ceratocombus (*Xylonannus*) *hawaiiensis* Usinger, 1946:633.

Kauai.

Immigrant. Source undetermined, but closely similar to the American *vagans* McAtee and Malloch. First found by Krauss beneath the bark of a dead tree at Waipahee, Kauai (type locality), in January, 1944.

This tiny, smoky-winged, peculiar bug is easily distinguishable from all other bugs in Hawaii. The hemelytra do not overlap behind, but are divergent caudad.

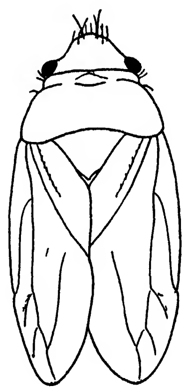


Figure 76—*Ceratocombus hawaiiensis* Usinger. (Outline sketch of holotype by J T. Yamamoto)

Family MIRIDAE (Hahn, 1831)

Mirides Hahn, 1831.

Capsinae Burmeister, 1835.

Capsidae Kirby, 1837.

Leaf Bugs

This is the largest family of Heteroptera. It is generically the most diversified of the Hawaiian bugs, and is only exceeded in numbers of known species by the Lygaeidae. However, the group has not been studied adequately, and there are many undescribed species as well as some new genera in our collections. It is the largest family of Hawaiian bugs, I believe, and it is probable that detailed study will reveal that only a modest fraction of the existing species has been described.

The family may be distinguished by the following diagnosis: ocelli absent; antennae four-segmented; rostrum four-segmented, the first segment as long as or longer than the head; hemelytra (when not brachypterous as in some species) with clavus, corium, fracture, cuneus (fracture and cuneus absent in ***Sulamita***) and membrane usually well developed, membrane with one or two closed cells (areoles), one larger than the other; tarsi three-segmented, claws with arolia in most genera and sometimes with pseudarolia.

Most of the species are small, delicate, soft bodied and need special care when being collected and mounted. Many of our species are beautiful insects and have striking colors, including greens and reds, arranged in pleasing patterns and shades. Most species are fast-moving insects, and some are difficult to capture.

There is a large number of species over the world which are of minor or major importance as pests of economic plants. We have several of these noxious species here, but we also have some species which have predaceous habits and are definitely beneficial and aid materially in the control of certain important crop pests.

It is known that many species of Miridae drill holes with their beaks and then force their ovipositors into the prepared holes to lay their eggs. One or two eggs to a puncture is the usual number. They may be inserted in soft growing tissue, in old woody tissues, in scars or in dead wood.

Blackburn (1888:348) said of this family:

The *Capsina* are, comparatively speaking, rather plentiful in the Hawaiian Islands. I possess upwards of forty species, of which I have not been able to send much more than a dozen to Dr. White. Unfortunately these are among the frailest of insects, and a great many of my species are represented by single types, some of them in inferior condition. From collecting expeditions I was usually obliged to bring home most of my captures unmounted, in sawdust, and the *Capsina* often suffered. The obscurity and difficulty of this group are so great that I think an entomologist who has not made them a special object of study would be more likely to hinder than assist future workers if he attempted to deal with them in print, and I act on this opinion by passing on without further remark....

Knight (1941:2) says,

Many mirid species have been observed to possess during nymphal development the curious habit or ability of protruding a posterior portion of the rectum; when a nymph is dislodged and falls from a branch or leaf to the foliage below, the rectum is protruded, and, being provided with sticky material, acts as an adhesion disk upon striking the foliage ot the limbs below. The nymph then scrambles for a foothold, pulls the adhesion disk free, retracts the rectum and runs for cover among the leaves. Thus the eversible rectal disk saves many falling nymphs from losing contact with the host plant.

It will be noted from the following text that considerable changes have been made in the arrangement of the Hawaiian members of the family. Study revealed that several of the genera had been assigned to subfamilies with which they had little in common. In spite of these changes, I realize that the group remains in great need of detailed study and thorough revision. We have accomplished little more than a preliminary survey of these interesting Hawaiian creatures.

Key to the Subfamilies of Miridae Found in Hawaii

1. Head, viewed from above, porrect, cone-shaped, eyes appearing to be slightly overlapped by prothorax; tylus strongly and peculiarly produced, laterally compressed, about as long, measured from side, as length of eye; head as in figure 95 (*Oronomiris*).........part of **Mirinae.**
   Head not so formed, even if porrect.................... 2

2(1). Fracture and cuneus absent, but hind femora never greatly enlarged for leaping (*Sulamita*)......part of **Bryocorinae.**
   Fracture and cuneus present, or hind femora greatly enlarged for leaping 3

3(2). Areoles of hemelytra each entire, not divided into a large and small cell by a vein (fig. 80).................... 4
   Areoles of hemelytra each divided into two cells by a vein (fig. 91) (look carefully; sometimes the small cell is difficult to see) or hind femora enlarged for leaping..... 7

4(3). Pronotum strongly inflated and conspicuously gibbose posteriorly (fig. 80) (*Pycnoderes*).......part of **Bryocorinae.**
   Pronotum not strongly gibbose posteriorly.............. 5

5(4). Tibiae with fine hair only and without numerous long slender spines ....**Cylapinae.**
   Tibiae with numerous, conspicuous, long, erect, slender spines in addition to shorter hairs.................... 6

6(5). Pronotum with a conspicuous collar............**Dicyphinae.**
   Pronotum without a collar................part of **Phylinae.**

7(3). Hemelytra without membrane, jumping species (*Halticus* and *Nesidiorchestes*).............part of **Heterotominae.**
   Hemelytra with membrane developed.................. 8

8(7). Pronotum with a distinct collar; tarsal arolia distinctly strongly divergent ....**Capsinae.**
   Without such a combination of characters................ 9

9(8). Arolia of tarsal claws conspicuous, finger- or flap-like, not bristle-like, curved or sinuate, distinctly convergent; tarsal claws normally widely divaricate.................10
   Arolia of tarsal claws absent or indistinct, if present, straight, erect and bristle-like but not fleshy or finger- or flap-like; tarsal claws normally divergent rather than divaricate in most of our species....................12

10(9). Tibiae hirsute or finely setose but not bearing spines (*Kalania*)........................part of **Bryocorinae.**
   Tibiae with numerous, long, conspicuous, well-developed spines 11

11(10). Pronotum with well-developed collar (*Nesiomiris*)..... ....part of **Mirinae.**
   Pronotum without a collar.................**Heterotominae.**

12(9). Eyes distinctly separated from thorax, head constricted and shortly neck-like behind them (see fig. 88 of *Cyrtorhinus*).......................part of **Heterotominae.**
   Eyes contiguous or subcontiguous to prothorax, obviously unlike *Cyrtorhinus*, but as in figures 77, 78.......**Phylinae.**

Subfamily PHYLINAE Reuter, 1910

In this group the hemelytral membrane has the cell divided into two areoles, the pronotum lacks a conspicuous collar, the tarsal arolia are either absent or bristle-like, the eyes are placed near the pronotum and the tylus is not compressed or protuberant as in the Mirinae.

Key to the Genera of Phylinae Found in Hawaii

1. Second antennal segment little longer than third, never conspicuously longer, but it may be heavier.... **Leucopoecila** Reuter.
   Second antennal segment much longer than third, longer than remainder of antenna in some forms.................... 2
2. Hemelytra with fine prostrate or reclinate hair only, without erect bristles; pale yellowish species; tibial spines not arising from dark spots...................... **Campylomma** Reuter.
   Hemelytra with two distinct types of setae, one fine, prostrate or reclinate, the other erect, or suberect, stouter, darker colored, conspicuous bristles; tibial spines arising from dark spots.................................... **Psallus** Fieber.

Genus LEUCOPOECILA Reuter, 1907:26

Leucopoecila albofasciata Reuter (fig. 77).
Leucopoecila albofasciata Reuter, 1907:26. Genotype.

The garden fleahopper.

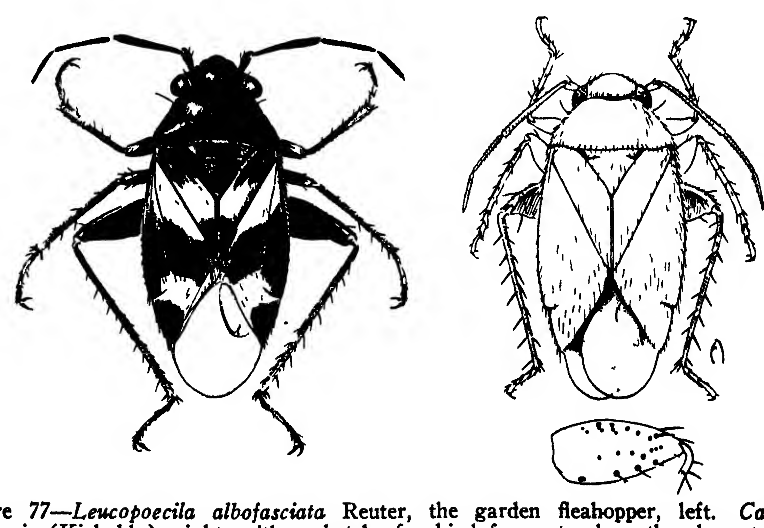


Figure 77—*Leucopoecila albofasciata* Reuter, the garden fleahopper, left. *Campylomma hawaiiensis* (Kirkaldy), right, with a sketch of a hind femur to show the characteristic dark spots. (Abernathy drawings.)

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. Widespread in North America. First found in the Territory by Terry in 1909 on Kauai.

Hostplants: beets, Bermuda grass, carrot, Chinese cabbage, corn, pigeon pea, *Portulaca,* nightshade, Swiss chard.

This is a nervous-acting, fast-moving bug that is difficult to capture—especially on a hot, bright day. It takes wing at slight disturbances. Sometimes it becomes abundant in gardens and is common in the field. The eggs are inserted in the leaves and stems of its hostplant. It occasionally comes to lights.

Both brachypterous and macropterous forms occur. The second antennal segment is enlarged in the male (conspicuously more swollen than in the female), and its lower surface is concave to form a large, conspicuous, sensory canal which extends almost the entire length of the segment.

It has been reported damaging seedlings of beets, carrots, chard, cabbage and pigeon pea in Hawaii by causing the cotyledons to shrivel with subsequent death of the young plants. The grass of golf course greens in some places in the United States has been damaged.

No satisfactory control measures have been worked out for it in Hawaii.

Genus **CAMPYLOMMA** Reuter, 1884

Genotype: *Campylomma nigronasuta* Reuter, fixed by Distant.
Opuna Kirkaldy, 1902:140, new synonym.

Campylomma reaches its greatest development in the Indo-Pacific regions. It is well developed in the islands from Fiji to the Marquesas (eleven species have been described from the Marquesas alone). The genus can be distinguished from our other Phylinae as follows: its second antennal segment is subequal in length to the third and fourth combined, thus separating it from *Leucopoecila;* from *Psallus* it differs by not having erect setae on the hemelytra (both genera have hair) and by lacking the dark spots at the bases of the spines on the tibiae. The dark spots at the bases of the femoral spines are not so well defined on our species as on some of those found elsewhere.

The single species established here has caused considerable confusion to local workers ever since it was so poorly and inaccurately described by Kirkaldy. He described *Opuna* as having a "wide collar" on the pronotum and stated that he had "placed this provisionally in *Halticaria,* notwithstanding its well-marked collar. It has the general appearance of an *Orthotylus.*" (1902:140.) His figure shows no such collar, and it has been suggested that the insect described and the one figured were different species. Mr. China has kindly examined Kirkaldy's unique type in the British Museum for me and has sent the following note: "*Opuna* Kirk. is undoubtedly synonymous with *Campylomma* Reuter. The collar mentioned by Kirkaldy is an optical illusion caused by the teneral state of the specimen whereby

the anterior third of the pronotum is transluscent so that the internal structure of the prothorax and occipital foramen of the head shows through, giving the appearance of a definite transverse suture. The upper surface of the pronotum is actually devoid of any transverse suture." Certainly one could not identify Kirkaldy's genotype from his description, but the confusion is at long last cleared up.

Campylomma hawaiiensis (Kirkaldy), new combination (fig. 77).
Opuna hawaiiensis Kirkaldy, 1902:140, pl. 5, fig. 29.
Campylomma hawaiiensis Usinger, 1943:287, fig. 1. New synonym.

Oahu (type locality: "S.E. Coast").
Immigrant. Known also from Wake Island and probably more widely spread.
Hostplant: *Sida.*
This species is easily recognized among our related Heteroptera, for it is unusually pale yellowish. It is a lowland species which has been found only in the Honolulu area.

Genus **PSALLUS** Fieber, 1858

Genotype: *Cimex roseus* Fabricius, fixed by Distant, 1904.

A widespread, nearly cosmopolitan genus with four described species in Hawaii, but there are undescribed species in our collections. A careful study of the Hawaiian members of the group will probably reveal a rather large complex of species here. As it now stands, the group is poorly known in these islands. The long second antennal segment (which is longer than the remainder of the antenna in some species) in combination with the spotted tibiae and two types of vestiture on the hemelytra will serve to separate our species from the members of *Leucopoecila* and *Campylomma* occurring here. The species closely resemble our *Orthotylus.*

In 1917 Van Duzee used *Apocremnus* Fieber, 1858, for this group because the name has page priority. However, he was not the first reviser, and *Psallus* stands.

On the mainland, especially in the southern states, a member of this genus is a serious pest. It is *Psallus seriatus* (Reuter), the cotton fleahopper, which attacks small cotton buds causing them to drop.

The Hawaiian forms are poorly known, and some confusion exists as to their proper names. A careful revision will be required to clarify the situation. An inquiry sent to Mr. China brought the following reply:

We have in our collection only one Hawaiian species of *Psallus,* that is *P. sharpianus* Kirk. We have a card on which two specimens had been mounted and one of which has been lost. The specimen (male) is labelled:—"Halemanu, Kauai 4,000 ft. Perkins V. 1895. *Psallus sharpianus* Kirk. Type. Specimen figured?" In running it down in your key I would scarcely call it mostly reddish. It would go better into the alternative since it is a pale testaceous. The hemelytra are scattered with distinct small fuscous spots. The hind femora of the lost

specimen, which remain on the card are pale with fuscous spots but those of the sole remaining specimen are pale with the spots very much less distinct. There is one more specimen (female) under this specific label and this is labelled "Kona, Hawaii 4,000 ft. 8. 1892 Perkins. Sharpi male, female, specimen figured." This specimen is minus antennae, legs and hemelytra and wings so that it is difficult to say what it really is. There is no variety *a* at all.

This poses several questions. Kirkaldy definitely states that typical *sharpianus* is a reddish species, and his colored figure leaves no doubt of this. Only one form was illustrated, but Mr. China points out that two examples are labeled as having been figured. Kirkaldy, in some supplementary notes (1908:197) published without access to his types, stated that the type of *sharpianus* was a "Kauaian specimen." As noted elsewhere, Kirkaldy made many confusing statements, and I believe this is another. It appears that the type of typical *sharpianus,* and the specimen figured, is the Kona, Hawaii, example which is now in fragments, and that the pale, testaceous form from Kauai (I have collected specimens on Kauai that agree with the description of this form) is what Kirkaldy called variety *"a."* Perhaps he labeled the pale form "specimen figured," and planned to figure it but such a figure was not published. The type of *pelidnopterus* should be in the British Museum with *sharpianus;* perhaps it has been lost or destroyed.

There may be some material in the Bishop Museum's and Perkins' shares of the *Fauna Hawaiiensis* material which would reveal certain details of value in interpreting the species of this group, but, unfortunately, that material was not available for study because of the war. It is on loan to Dr. Usinger.

Key to the Hawaiian Psallus

1. Species mostly reddish in color 2
   Fuscous or testaceous species 3

2(1). Hemelytra unspotted .... **kirkaldyi** (Perkins).
   Hemelytra with scattered but distinct small fuscous spots .... **sharpianus** Kirkaldy.

3(1). Hind femora broadly infuscated........... **swezeyi** Kirkaldy.
   Hind femora pale or pale with fuscous spots............... 4

4(3). "Blackish-brown, cuneus (more or less), femora (more or less), apical half of head, lateral margins (widely) of pronotum, and two spots at base of pronotum—yellowish" (original description) .... **pelidnopterus** (Kirkaldy).
   Pale testaceous, hemelytra with scattered, small dark spots .... **sharpianus luteus** Zimmerman.

Psallus kirkaldyi (Perkins), new combination.
Tichorhinus kirkaldyi Perkins, 1912:731.

Endemic. Hawaii (type locality: Kilauea).
Hostplant: *Styphelia* (*Cyathodes*).
This species has the characters of *Psallus,* not of *Orthotylus* (*Tichorhinus*), and must be transferred. The types are in the Bishop Museum.

Psallus pelidnopterus (Kirkaldy).

Psallus sharpianus variety *pelidnopterus* Kirkaldy, 1902:132.

Psallus pelidnopterus (Kirkaldy) Kirkaldy, 1909:197.

Endemic. Hawaii (type locality: Hualalai, 5,000 feet).

Hostplant: *Acacia koa.*

I do not know where the type is. I have been unable to find it in Hawaii, and the species is not represented at the British Museum.

Psallus sharpianus Kirkaldy (fig. 78).

Psallus sharpianus Kirkaldy, 1902:131, pl. 5, fig. 31; 1908:197.

Endemic. Kauai, Maui, Hawaii (type locality: Kona, 4,000 feet).

Hostplants: *Acacia koa, Euphorbia.*

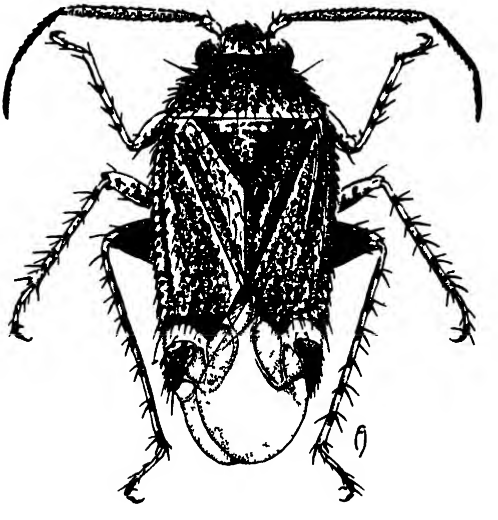


Figure 78—*Psallus sharpianus* Kirkaldy. (Abernathy drawing.)

Psallus sharpianus variety **luteus,** new name.

Psallus sharpianus variety *a* Kirkaldy, 1902:132.

Endemic. Kauai (type locality: Halemanu, 4,000 feet), Oahu, Maui, Hawaii.

Hostplant: *Acacia koa.*

Kirkaldy said that this form differs from typical *sharpianus* because it has the sanguineous coloring replaced by luteous. It may be a distinct species.

Psallus swezeyi Kirkaldy.

Psallus swezeyi Kirkaldy, 1910:120.

Endemic. Oahu (type locality: Waianae Mountains, 2,000 feet).

Hostplant: *Pipturus*.

The holotype is in the Hawaiian Sugar Planters' Association Experiment Station, Honolulu.

Subfamily DICYPHINAE Oshanin, 1912

Our members of the Dicyphinae may be distinguished from our other subfamilies of bugs by the following combination of characters: body elongate, slender; pronotum with a conspicuous collar; cell of hemelytral membrane not divided into two areoles, and tibiae with well-developed spines. A single genus represents the group in Hawaii.

Genus ENGYTATUS Reuter, 1875

Our species have been included in the genus *Cyrtopeltis*, but Dr. Usinger says that *Engytatus* should be used for them (see his detailed discussion, 1946:73–75). One immigrant plant pest and two native species have been recorded from Hawaii, but there are a number of new species awaiting description in local collections. The genus is a large one in our fauna, I believe. The asymmetrical male genitalia display fine specific characters which undoubtedly will be used extensively when future workers revise the group.

Key to the Hawaiian Species of Engytatus

1. Second antennal segment more than twice as long as breadth of head across eyes........................**confusus** (Perkins).

   Second antennal segment less than twice as long as breadth of head across eyes 2

2. Narrowest interocular distance about three-fourths as great as length of median line of pronotum from base to collar; second antennal segment but little longer than breadth of head across eyes; dorsum yellow, not infuscate or maculate; setae of corium spine-like, dark colored as compared with corium; antennae predominantly yellow........**hawaiiensis** (Kirkaldy).

   Narrowest interocular distance about one-half as long as median line of pronotum from base to collar; second antennal segment one-third longer than breadth of head across eyes; dorsum infuscate and maculate; setae of corium fine, hair-like, pale; antennae predominantly dark.....**geniculatus** Reuter.

Engytatus confusus (Perkins) (fig. 79).

Cyrtopeltis confusa Perkins, 1912 (1911):729, fig. *a*.

Engytatus confusus (Perkins) Usinger, 1946:75.

Endemic. Oahu (type locality not further delimited by Perkins, but probably from the Mount Tantalus region).

Hostplants: *Cyrtandra, Gouldia* (common on this host), *Straussia, Touchardia.*

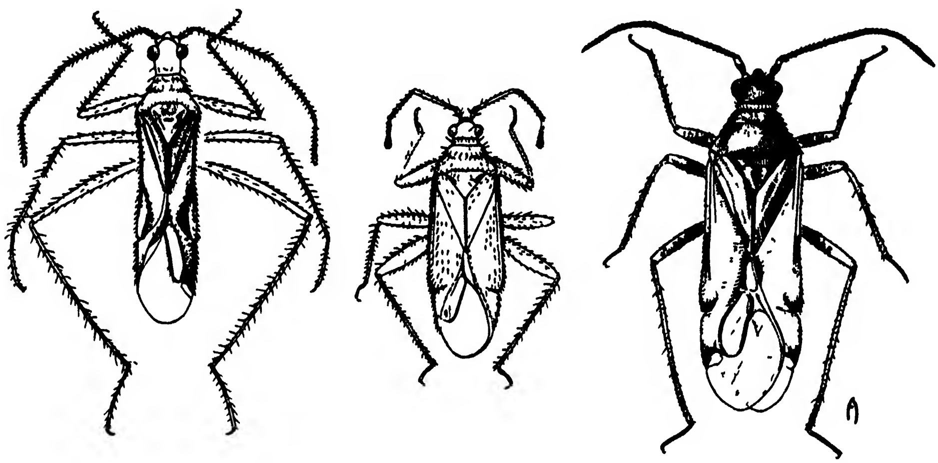


Figure 79—*Engytatus confusus* (Perkins), left. *E. hawaiiensis* (Kirkaldy), middle. *E. geniculatus* Reuter, right. (Drawings by Abernathy; not to same scale.)

Perkins (1912:730) wrote concerning this species and *hawaiiensis*:

This is the species referred to by Kirkaldy in his supplement to the Hemiptera, "Fauna Haw.," II, p. 553, as *Cyrtopeltis hawaiiensis*, but it clearly has nothing to do with that species, described in the same work, p. 138. The original series of *C. hawaiiensis*, excepting the type set, was destroyed during one of Mr. Kirkaldy's illnesses in hospital for want of attention. There was therefore no reason to assume, without comparison of specimens, that his original description of *Cyrtopeltis* was erroneous. I have an example from near the Waianae coast of Oahu, which agrees exactly with Kirkaldy's description of *C. hawaiiensis*, but is rather smaller. I should think *C. confusa* is decidedly not even congeneric with *C. hawaiiensis*, the very different antennae and pronotum, the larger and more coarsely faceted eyes and many other distinctions separating the two. At present, however, it is only necessary to call attention to the existing confusion of species with entirely different habits and appearance, especially as *C. confusa* is one of the most familiar endemic Hemiptera of the Honolulu district. *C. hawaiiensis* will probably be found on *Dodonaea viscosa*, which grows freely both above and below the true forest belt.

Engytatus geniculatus Reuter (fig. 79).

Engytatus geniculatus Reuter, 1876:83. Genotype.

Cyrtopeltis geniculatus (Reuter), not of Fieber.

Cyrtopeltis varians (Distant), as a misidentification.

The tomato bug.

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant from the United States. First found in the Territory by Swezey in Manoa Valley, Honolulu, in 1924.

Hostplants: *Gynandropsis pentaphylla, Lagenaria* (gourd), *Plumbago,* tobacco, tomato, squash.

This species has in recent years become a pest of importance in Hawaii where it causes severe losses to the tomato crop. The bugs feed on the stems of the flower buds, ringing them with punctures and causing the buds to drop off before opening, thus reducing set of fruit. The exact nature of the cause of the so-called "blossom drop" has not been satisfactorily explained. Some workers have thought that egg laying caused the blossoms to drop, others believe that there is a physiological upset resulting from the feeding punctures, and some workers have considered soil deficiencies and other factors to be involved and that the bug was not a serious factor in blossom drop. It appears, however, that this bug is really a culprit and does cause blossom drop. Illingworth thought that it might be involved in the transmission of a mosaic disease, but no conclusive data have been presented.

These insects have predaceous as well as herbivorous habits, for they are known to feed upon mealybugs, aphids, eggs and young lepidopterous larvae (including those of the cabbage butterfly), and other small insects. They occasionally are attracted to lights and are active at night.

The nymphs pass through five stages in about nine or ten days. The first stage nymphs are yellowish with very conspicuous red eyes. Second stage, lighter color, more greenish and active, eyes brown. Third stage, greener body, yellowish head, nodes and distal segment antennae blackish. Fourth stage, more green, wing pads beginning to show, eyes blackish. Fifth stage, very green, eyes darker, wing buds reaching one-third the length of the abdomen. (Illingworth, 1937:457–458.)

Control: Illingworth reported good control by using a fine fog spray of one quart Pyrethrum 20 to five gallons of deo-base oil.

Engytatus hawaiiensis (Kirkaldy) (fig. 79).

Cyrtopeltis hawaiiensis Kirkaldy, 1902:138.

Engytatus hawaiiensis (Kirkaldy) Usinger, 1946:75.

Endemic. Oahu, Maui (type locality: Haleakala Crater).

Hostplants: *Raillardia* sp., *Raillardia menziesii.*

Kirkaldy (1910:553) altered his original description, but was in error by doing so. He confused another species with *hawaiiensis.* See Perkins' explanation and discussion under *E. confusus* above.

Subfamily BRYOCORINAE Douglas and Scott, 1865

The three genera representing this subfamily in Hawaii are easily distinguished as follows: eyes contiguous to thorax, second antennal segment longer than the following two segments together, pronotum usually conspicuously convex and inflated or gibbose; *Pycnoderes* and *Sulamita* have each hemelytral areole entire, not divided by a vein into two cells, but it is divided in *Kalania;* fracture and cuneus absent in the peculiar endemic *Sulamita;* tibiae not spinose.

Key to the Tribes of Bryocorinae Found in Hawaii

1. Fracture and cuneus absent........................**Sulamitini.**
   Fracture and cuneus present............................ 2
2. Hemelytral areoles entire........................**Pycnoderini.**
   Areoles each divided into two cells by a distinct vein.....**Kalaniini.**

Tribe PYCNODERINI (Reuter, 1910)

Genus **PYCNODERES** Guérin-Méneville, 1857

We have one Neotropical immigrant garden pest to represent this genus in Hawaii. It is a conspicuous, distinct and easily recognized species.

Pycnoderes quadrimaculatus Guérin-Méneville (fig. 80).
Pycnoderes quadrimaculatus Guérin-Méneville, 1856:169.

The bean mirid (bean capsid).

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant from the United States mainland; originally a Neotropical species. First found in the Territory by Illingworth in 1929 on Oahu.

Hostplants: *Cucumis dipsaceus,* cucumber, dishcloth gourd, garden bean, lima bean, okra, pole bean, *Portulaca,* pumpkin, spiny cucumber, squash, sweet potato, white mustard cabbage.

Parasite: *Anagrus yawi* Fullaway (Hymenoptera: Mymaridae), introduced from Mexico in 1943.

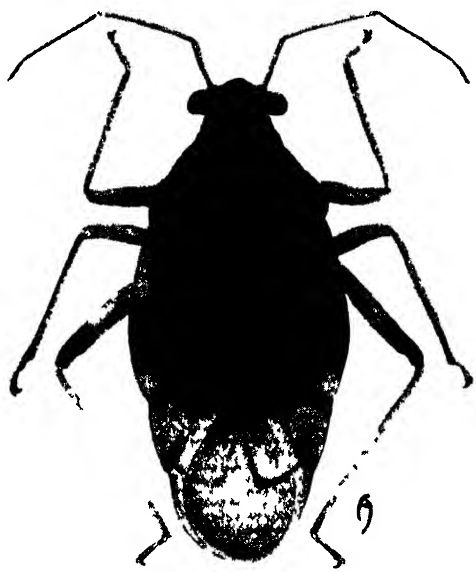


Figure 80—*Pycnoderes quadrimaculatus* Guérin-Méneville, the bean mirid. (Abernathy drawing.)

This species, whose salient and distinctive features are clearly demonstrated by our illustration, has become a pest of considerable importance to the growers of green beans in Hawaii, especially in the drier areas. At times, the bugs become excessively abundant on bean foliage, which becomes heavily spotted with black excrement beneath; the upper surface becomes pale speckled. The bug is attracted to lights.

On the mainland, this species is variously known as the squash capsid, the cucumber, melon or cassaba bug and is reported by Essig (1929:363) as "a pest to cucurbs and is particularly injurious to cucumbers, cassaba, cantaloupes, muskmelon, squash and watermelon, but also feeds on beans, lettuce, other garden vegetables, and weeds."

Control: various dusts and sprays give good control. The Hawaii Agricultural Experiment Station found that a 3 percent nicotine-lime dust and a "1:600 nicotine sulfate plus 1 pt. per 100 gal. fish-oil soap" gave satisfactory control.

A fungus (*Entomophthora sphaerosperma* Fresenius) attacks the bugs and they are preyed upon by *Zelus renardii*, a reduviid.

Tribe SULAMITINI, new tribe

Division *Sulamitaria* Kirkaldy, 1902:129.

This is an endemic group chiefly characterized by the peculiar absence of the usual mirid fracture and cuneus of the hemelytra. Kirkaldy's original diagnosis

(1902) reads "No trace of a cuneal suture in either form. Anterior part of scutellum covered, no pronotal collar. Pronotum and elytra impresso-punctate, membrane with two cells (one obsolete), clavus distinct, corium with a central nervure; wings with an areole, no hamus. Posterior coxae almost contiguous, remote from lateral margin of body; posterior femora subelongate, not incrassate."

In answer to my inquiries, W. E. China has kindly sent me the following information from the British Museum:

Sulamita is undoubtedly a member of the Bryocorinae and I think you are right in considering it as representing a distinct tribe, Sulamitini, based largely on the absence of a cuneus. This genus is obviously derived from the Prodromini (*Prodromus* Dist. and *Stenopterocoris* China) which are represented by four oriental species and two African species of the former and one African species of the latter. *Prodromus* agrees with *Sulamita* in having a strongly convex regularly punctate pronotum, small scutellum, cuneus feebly delimited from corium, embolium very narrow and parallel sided and membranal cell very long, extending nearly to apex of cuneus. No doubt when the Miridae are better known there will be found in the Austro-Oriental region (Melanesia), connecting links between *Prodromus* and *Sulamita* which will better show how *Sulamita* and *Prodromus* have been related in the past. The posteriorly carinate vertex of *Sulamita* is very distinctive although *Stenopterocoris* has a similar very broad vertex posteriorly between the eyes. The latter are more prominent, almost pediculate in the Prodromini.

Genus **SULAMITA** Kirkaldy, 1902:129

There have been four species described thus far, but there are new forms in the collection studied. The status of *oreias* and *dryas* has been in doubt because Kirkaldy gave no adequate summary of diagnostic characters which would enable them to be recognized now. Usinger has pointed out to me that Perkins designated types from Kirkaldy's material after the latter's death, but that the new type localities do not agree with the localities cited by Kirkaldy; therefore Perkins' type designations appear to be invalid, but the problem requires further study.

Both macropterous and brachypterous forms occur.

Key to the Species of Sulamita

This key was prepared by W. E. China and is based upon the types in the British Museum.

1. Anterior lobe of pronotum yellow; puncturation of head very sparse along posterior margin, no distinct median line of punctures present; puncturation of pronotum relatively sparse .... **opuna** Kirkaldy.

   Anterior lobe of pronotum black; puncturation of head relatively dense along posterior margin of vertex, a distinct median line of punctures present; puncturation of pronotum dense 2

2(1). Posterior lobe of pronotum yellow; hemelytra without brown markings except for a narrow brown border to apical margin of corium........................**dryas** Kirkaldy.

Black coloration extending over greater part of posterior lobe of pronotum; hemelytra with a distinct semicircular marking across both coria............................ 3

3(2). Clavus black except for a narrow pallid border along claval commissure; first antennal segment longer than breadth of vertex between eyes..................**lunalilo** Kirkaldy.

Clavus mainly pallid with slight infuscation at base along claval suture; first antennal segment shorter than width of vertex between eyes...................**oreias** Kirkaldy.

Sulamita dryas has the relative lengths of antennal segments 1 and 2 as 32:72, whereas they are as 40:95 on *lunalilo.*

Sulamita dryas Kirkaldy (fig. 81, a).
Sulamita lunalilo, variety, Kirkaldy, 1902:130, pl. 4, fig. 12.
Sulamita dryas Kirkaldy, 1908:197.

Endemic. Hawaii (type locality: Kilauea).

A specimen in Perkins' collection at the Bishop Museum, collected by him at 3,000 feet on Lanai, was identified by Perkins as this species.

Sulamita lunalilo Kirkaldy (fig. 81, b).
Sulamita lunalilo Kirkaldy, 1902:130, pl. 4, figs. 12a, 14. Genotype.
Kirkaldy's pl. 4, fig. 12, applies to *S. dryas,* and fig. 13 to *oreias.*

Endemic. Kauai, Oahu, Lanai, Hawaii (type labeled "Makulaiia"; paratypes from Kona).

Hostplants: *Freycinetia, Xanthoxylum.*

Sulamita opuna Kirkaldy (fig. 81, d).
Sulamita opuna Kirkaldy, 1902:131.

Endemic. Oahu (type locality: Mount Kaala, 2,000 feet).

Hostplants: *Claoxylon, Pisonia, Xanthoxylum.*

Sulamita oreias Kirkaldy (fig. 81, c).
Sulamita oreias Kirkaldy, 1908:197.

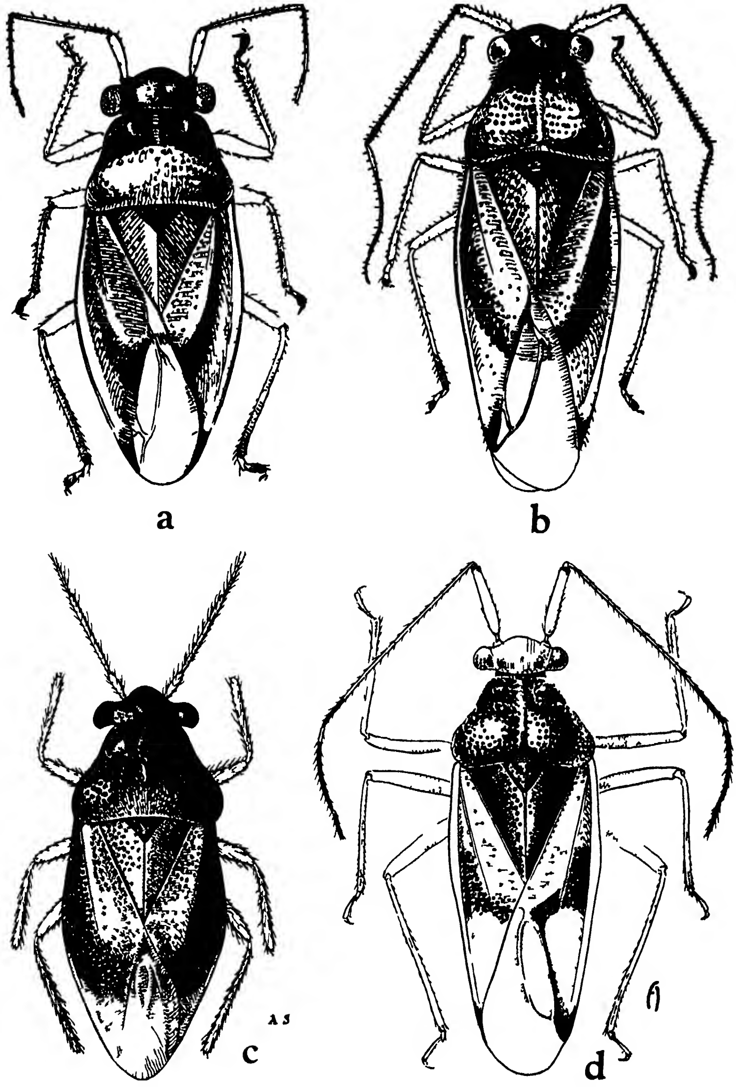


Figure 81—The species of *Sulamita* a, *S dryas* Kirkaldy (antennae reconstructed); b, *S. lunalilo* Kirkaldy, c, *S oreias* Kirkaldy, holotype, d, *S. opuna* Kirkaldy (Drawing c by Smith; others by Abernathy.)

Endemic. Kauai No locality was given for this species by Kirkaldy, but the holotype bears Perkins' field number 631 which indicates that it was collected on Kauai on the "High Plateau, VIII '96."

Kirkaldy's 1902, pl. 4, fig 13 belongs to this species, and the figured specimen will be the type. This example is illustrated herewith. A specimen bearing the following label is in Perkins' collection at the Bishop Museum: "Kauai 4000 ft. 1.02. *S. oreias* det RCLP."

Tribe KALANIINI, new tribe

This tribe is erected to receive our peculiar genus *Kalania* which has the pronotum margined at apex but without a collar; no hamus in cell of hind wing; fore wing with membrane areoles each divided into two areolets; tibiae not spinose; tarsi with first and second segments with longest chords subequal, third segment slightly swollen, slightly longer, the arolia fleshy and convergent. The antennae of the only known species has the first segment only one-fourth as long as the second which is longer than the following two together.

Genus KALANIA Kirkaldy, 1904:280

Baracus Kirkaldy, 1902:143, preoccupied.

Kalania is a peculiar genus. In our fauna it most closely resembles *Sarona,* next to which it was placed by Kirkaldy. It is easily distinguished from that genus, however, because it has a strongly protuberant scutellum and the tibiae are not spinose. As in *Sarona,* the head overlaps the apex of the pronotum, and the pronotum is margined at the apex where the base of the head fits against it. Only one species has been seen by me, and it is a rarity. Mr. China has kindly examined the type, and he agrees that a new tribe should be erected for it. He writes that it superficially might be placed in Reuter's division Perissobasaria (South America) because of the divided areoles of the fore wings which are unusual in the subfamily, but that the absence of a distinct pronotal collar on *Kalania* readily separates it from that group.

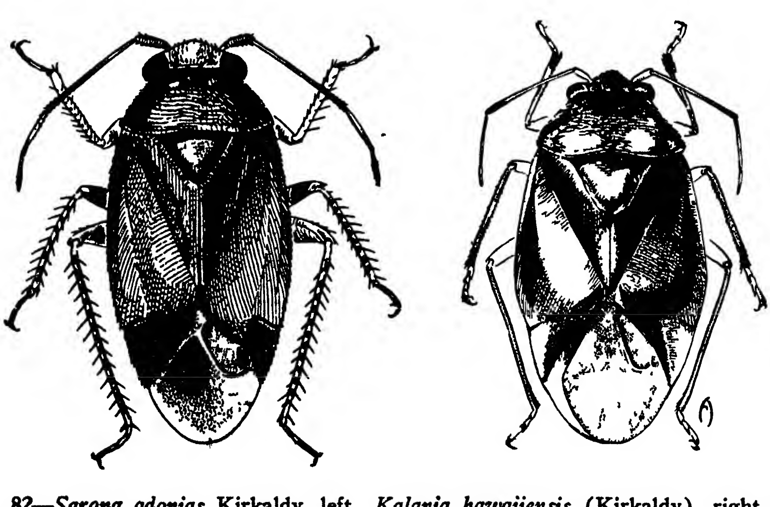


Figure 82—*Sarona adonias* Kirkaldy, left. *Kalania hawaiiensis* (Kirkaldy), right. (Drawn to same scale by Abernathy.)

Kalania hawaiiensis (Kirkaldy) (fig. 82).
Baracus hawaiiensis Kirkaldy, 1902:143, pl. 4, fig. 21.
Kalania hawaiiensis (Kirkaldy) Kirkaldy, 1904:280.

Endemic. Lanai (type locality: 2,000 feet).

Subfamily CYLAPINAE (Poppius, 1909)

A single immigrant species is the only representative of this group thus far recorded in Hawaii. The subfamily may be distinguished by the following combination of characters: head porrect, somewhat produced in front of eyes; areoles of hemelytral membrane entire; pronotum with a collar, not gibbose; tibiae setose but not spinose; tarsi without arolia. The group is mostly predaceous in habit.

Genus FULVIUS Stål, 1862

Fulvius is a cosmopolitan genus. Its members somewhat resemble lygaeids.

Fulvius peregrinator Kirkaldy (fig. 83).
Fulvius peregrinator Kirkaldy, 1910:120.

Kauai, Oahu, Hawaii. (Type locality not designated by Kirkaldy.)

Immigrant. I have collected it in Samoa, and it is probably more widely spread in the Pacific.

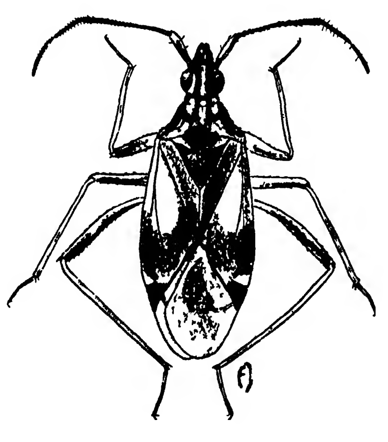


Figure 83—*Fulvius peregrinator* Kirkaldy. (Abernathy drawing.)

This species has been found in banana trash, sugarcane damaged by weevils and in similar places. It is evidently predaceous and probably has cryptic habits. A knowledge of the life history of this mirid is needed.

"Pemberton found a bug rather similar to this one that destroyed the eggs of a palm beetle-borer of the genus *Rhabdocnemis* in the Philippine Islands." (Williams, 1931:103.)

Subfamily HETEROTOMINAE Reuter, 1910

This is our most extensively developed mirid subfamily. It contains a number of complexes, is polymorphic, and is a difficult group. Because of the diverse groups of insects included, a brief, inclusive diagnosis of the subfamily is not easily written. The areoles of the hemelytral membrane are each divided into two cells (*Halticus* and *Nesidiorchestes* may lack the membrane, however); the pronotum lacks a collar; the tarsal arolia are present and usually finger- or flap-like (except in *Cyrtorhinus*, in which genus they are abnormally specifically variable); in *Pseudoclerada* the head is porrect, in the other genera it is deflexed.

Key to the Tribes of Heterotominae Found in Hawaii

1. Head porrect .... **Pseudocleradini.**
   Head deflexed 2
2. Hind femora enlarged for leaping or head strongly embracing pronotum (anterior edge of pronotum covered by head) or both .... **Halticarini.**
   Hind femora not enlarged for leaping; head usually obviously not overlapping fore edge of pronotum and fore edge of pronotum not extending anterior to hind edges of eyes (view from side) .... **Heterotomini.**

Tribe HALTICARINI (Kirkaldy)

Division *Halticaria* Kirkaldy, 1902:139.

The genera *Halticus* and *Nesidiorchestes* include leaping insects with enlarged femora, especially prominent in *Nesidiorchestes*. The hind femora of the *Sarona* species are not so strongly expanded, and these bugs are not such characteristic jumping insects. The species of *Halticus* has long- and short-winged forms; the species of *Nesidiorchestes* is entirely brachypterous and cannot fly, and that of *Sarona* is always macropterous.

Key to the Genera of Halticarini Found in Hawaii

1. Membrane of hemelytra absent 2
   Membrane of hemelytra present 3

2(1). First antennal segment not longer than greatest chord of an eye; dorsum with scattered, conspicuous ovate scales.... ....brachypterous **Halticus** Hahn.
   First antennal segment distinctly longer than greatest chord of an eye; dorsum without scales..**Nesidiorchestes** Kirkaldy.

3(1). Head from top to apex of tylus much narrower than breadth across eyes; dorsum, excepting membrane, distinctly, densely punctate, without squamae; hemelytra with fracture slightly and indistinctly notched......**Sarona** Kirkaldy.
   Head as long as or slightly longer than broad; dorsum not distinctly punctate, with easily abraded, ovate, distinct squamae; hemelytra with fracture deeply, broadly, conspicuously emarginate........macropterous **Halticus** Hahn.

Genus NESIDIORCHESTES Kirkaldy, 1902:139

This is a peculiar endemic genus of small, leaping bugs. The single species known is brachypterous, the hemelytra have no membrane, and the hind femora are greatly enlarged.

Nesidiorchestes hawaiiensis Kirkaldy (fig. 84).

Nesidiorchestes hawaiiensis Kirkaldy, 1902:139, pl. 4, figs. 15, 16. Genotype.

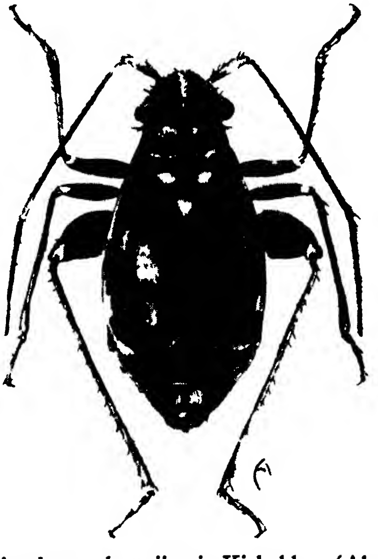


Figure 84—*Nesidiorchestes hawaiiensis* Kirkaldy. (Abernathy drawing.)

Endemic. Oahu (type locality: northwest Koolau Mountains, 2,000 feet).

I have collected this remarkable species by sifting dead leaves and ground litter in the mountains behind Honolulu. It is an agile and active jumper. I have seen it make leaps of about 1.5 inches high and 3 inches long in rapid succession.

Genus **HALTICUS** Hahn, 1832

Genotype: *Cicada aptera* Linnaeus, the only species included by Hahn.

A single immigrant species represents this genus in Hawaii. Both brachypterous and macropterous forms occur. The hind femora are greatly enlarged for leaping and the dorsum of the body has scattered, easily abraded squamae. This genus and *Nesidiorchestes* are our only genera in which the hind femora are so greatly swollen for leaping. However, they should not be easily confused, and the characters outlined in the key are ample for their separation.

If the exact date of publication of *Eurycephala* Laporte is established, that genus may replace *Halticus*.

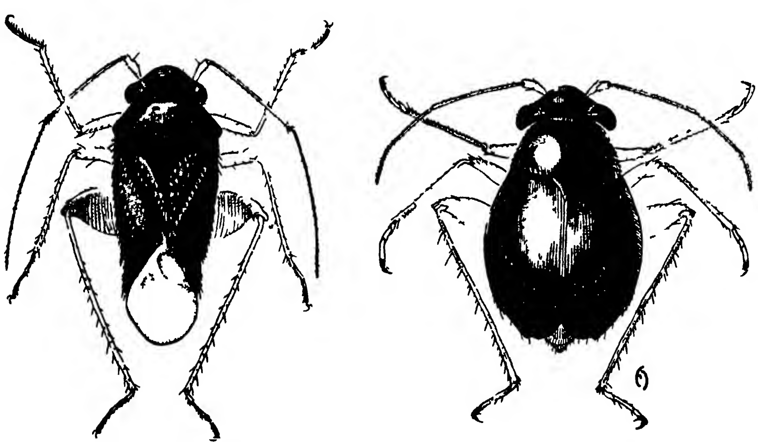


Figure 85—*Halticus chrysolepis* Kirkaldy, long- and short-winged forms (Abernathy drawings; right figure eleven-tenths the size of the left)

Halticus chrysolepis Kirkaldy (fig. 85).
Halticus chrysolepis Kirkaldy, 1904:179.

Oahu (type locality: Honolulu).

Immigrant. Source?

Hostplants: *Carex, Cynodon dactylon, Digitaria henryi,* "grasses."

This is a largely shiny black species, the hind femora are reddish-orange in life, and the dorsal squamae are iridescent green. It is often abundant in truck gardens

The short-winged form may appear to one unfamiliar with the dimorphism to belong to a different genus from the long-winged form.

It is strange that this species has not yet been matched up with any of the species occurring elsewhere.

Genus **SARONA** Kirkaldy, 1902:142

This endemic genus is allied to no other in Hawaii, nor does it resemble any of our other mirids excepting *Kalania*. It appears to be an offshoot of Palearctic *Strongylocoris*. The body is stouter and more heavily sclerotized than in most of our other groups, the head is broad and short, the rostrum extends to or beyond the apex of the metacoxae, the hind femora are stout, and the entire insect has a distinctive facies that is apparent in the illustration.

Only one species has been described, but many new forms are in local collections. Perhaps more than a score of species will be described when the genus is studied carefully. The male genitalia display remarkable specific characters.

Sarona adonias Kirkaldy (fig. 82).
Sarona adonias Kirkaldy, 1902:142, pl. 5, fig. 23. Genotype.

Endemic. Molokai, Lanai, Maui, Hawaii (type locality: Kilauea; Kirkaldy, 1908:198).

Hostplants: *Metrosideros, Pelea*. Frequents flowers.

Tribe PSEUDOCLERADINI, new tribe

This tribe is erected for our peculiar endemic genus *Pseudoclerada* which Kirkaldy placed in his division Halticaria. Mr. China agrees that it cannot be retained in that tribe because of its unusual, porrect head. The cone-shaped head of the members of this tribe recalls that of certain predaceous bugs, and it is possible that this group has also developed a predaceous habit. The drawings show well the major characteristics of the tribe without the need of detailed explanation. The first two tarsal segments are subequal in length (measured along their greatest chords), the third segment a little longer than second; arolia convergent, membranous, finger-like. There is no hamus in the cell of the hind wing. Eyes very large, prominent; tylus protuberant. Pronotum without a collar.

Genus **PSEUDOCLERADA** Kirkaldy, 1902:140

This is one of our most peculiar bug genera, and its broad form combined with its porrect head will serve to distinguish it from the other mirids. Both macropterous and brachypterous forms occur.

Representatives of this genus have been collected on all of the main islands, and have been assigned to two species. I feel that confusion exists and that there are more than two species represented. There surely appear to be more than two species in the collections I have examined; perhaps almost every island has a distinct form. I have, therefore, questioned the locality records, other than the type localities, for the two described species. In answer to my request for information regarding the types in the British Museum, Mr. China sent the following comments:

I have examined the specimens of *Pseudoclerada morai* Kirk. in our collection and find that there are two species represented. The typical *P. morai* Kirk. has larger eyes in both sexes than *P. kilaueae* and the vertex between the eyes in the type male is very narrow. It is represented by the type male Molokai Mts. 3,000 ft. Perkins 1893, and three females—Honolulu, Oahu, 2,000 ft. Perkins 1896; 847 Hon. Mts. 12.1900; and Waialua, Koolau Range, Oahu, Perkins 1893. All the remaining specimens belong to a species with smaller eyes in both sexes (presumably *kilaueae* Kirk.). There is no specimen from Kilauea but there is a specimen labelled "figured" without precise locality, which could be regarded as the type (female). There are five other specimens including a male, which also has no precise locality. The remaining two specimens of *P. kilaueae* are from Kona, Hawaii, 4,000 ft., Perkins 1892, and Lanai, 2,000 ft. Perkins 1.1894. There is one broken specimen with head missing which cannot be identified. This makes thirteen specimens in all.

Kirkaldy did not have the specimen which China mentions as the female type of *kilaueae* before him when he described the species, for he was in Honolulu when he wrote the description which was based upon his figure in *Fauna Hawaiiensis*. It is the type, however, because it was the example used for the *Fauna Hawaiiensis* drawing.

Key to the Species of Pseudoclerada

Prepared from the types at the British Museum by Mr. W. E. China

1. Females. Vertex between eyes more than twice as wide as an eye (11:4.5)............................**kilaueae** Kirkaldy.
   Vertex between eyes less than twice as wide as an eye (12:6.5) .... **morai** Kirkaldy.
2. Males. Vertex between eyes at narrowest point, about two-thirds the width of an eye (7:9.5).........**kilaueae** Kirkaldy.
   Vertex between eyes at narrowest point one-half width of an eye (6:12)..................................**morai** Kirkaldy.

Pseudoclerada kilaueae Kirkaldy (fig. 86).

Pseudoclerada kilaueaë Kirkaldy, 1908:198.

Kirkaldy's figure, 1902, pl. 4, fig. 19, applies to this species, not to *morai.*

Endemic. Lanai (?), Hawaii (type locality: Kilauea).

Kirkaldy's original description says only that "This has nothing to do specifically with *morai,* the eyes being much smaller, and the pattern and coloring quite dif-

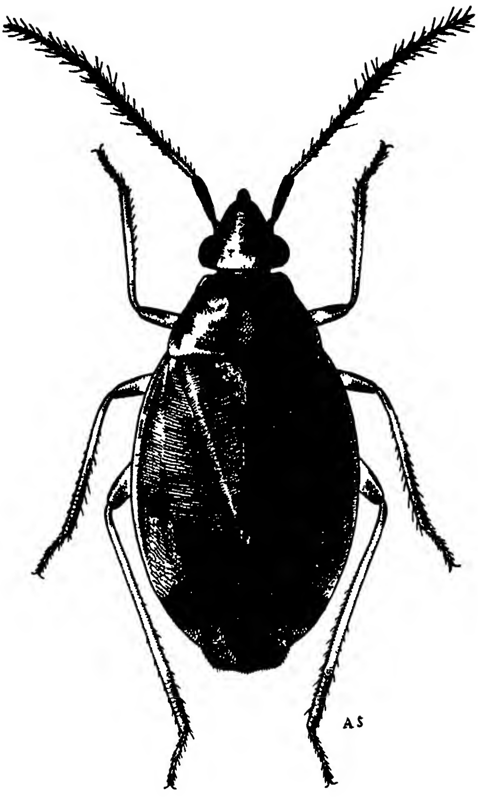


Figure 86—*Pseudoclerada kilaueae* Kirkaldy, holotype. (This is the same example as used by Kirkaldy, 1902, pl. 4, fig. 19, and misidentified there as *P. morai.*) (Drawn by Smith at the British Museum of Natural History.)

ferent." He may have come to the decision that this was a distinct species simply by examining his *Fauna Hawaiiensis* illustrations. This is a much smaller species than *morai*. The type in the British Museum is figured here.

Pseudoclerada morai Kirkaldy (fig. 87).

Pseudoclerada morai Kirkaldy, 1902:141, pl. 4, figs. 18, 18a.

Endemic. Kauai(?), Oahu(?), Molokai (type locality; Kirkaldy, 1908:198), Lanai(?), Maui(?), Hawaii(?).

Hostplants: *Elaeocarpus, Freycinetia, Pipturus, Tetraplasandra.*

Specimens have been found under dead bark and in hollow stems. The species may be predaceous, but nothing is known of its habits.

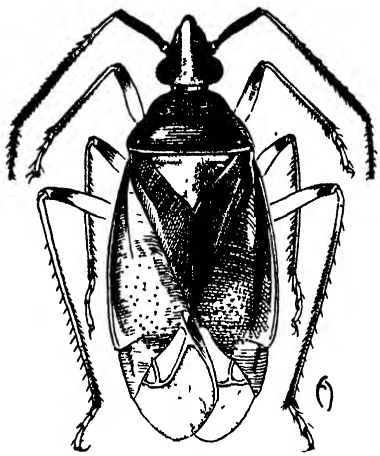


Figure 87—*Pseudoclerada morai* Kirkaldy. (Note: The "neck" is not always visible as is shown here.) (Abernathy drawing.)

Perkins (1913:ccii) noted that "There is great sexual difference in the development of the eyes, and brachypterous forms occur. The species inhabits damp shady places in the forest and has been found beneath bark of dead branches of trees, and also amongst the moss or creeping ferns growing on these. Like *Metrarga,* they hide at the bases of the leaves of *Freycinetia,* where rubbish accumulates."

Tribe HETEROTOMINI (Kirkaldy)

Division *Heterotomaria* Kirkaldy, 1902:132.

The members of this widespread group have a distinctive facies which is well displayed by the illustrations. I am not sure that *Koanoa* is correctly placed here.

Key to the Genera of Heterotomini Found in Hawaii

1. Rostrum extending behind metacoxae.. **Kamehameha** Kirkaldy.
   Rostrum not reaching behind metacoxae................ 2

2(1). Hind margin of head not vertical, but horizontal, most posterior part shiny and somewhat narrowly "neck-like" .... **Cyrtorhinus** Fieber.
   Hind margin of head vertical or nearly so, not neck-like, fitting closely to pronotum.......................... 3

3(2). Second antennal segment not reaching beyond posterior edge of pronotum; fracture of hemelytra deeply and conspicuously emarginate .... **Koanoa** Kirkaldy.
   Second antennal segment reaching to far beyond posterior edge of pronotum; fracture of hemelytra usually shallowly emarginate...................... **Orthotylus** Fieber.

Genus CYRTORHINUS Fieber, 1858

Cyrtorrhinus (Fieber) Reuter, 1884.
Genotype: *Capsus caricis* Fallen, the only species included by Fieber.

Two imported species represent this almost cosmopolitan genus in Hawaii. Usinger (1939:271–273) reviewed the distribution and host relationships and gave notes on the habits of the group. The genus is an economically important and valuable one, for its species feed upon the eggs of delphacid leafhoppers and are thus beneficial.

These bugs somewhat resemble *Nesiomiris,* but they lack the pronotal collar of that genus. "An apparent structural anomaly in *Cyrtorhinus* which has not been given sufficient attention is the absence, in certain species, of arolia between the claws. In such cases two very fine, small, parallel setae are the only structures to be seen between the claws. The presence or absence and form of the arolia is usually a very reliable guide to relationships in the Miridae . . ." (Usinger, 1939:272.) Our species *fulvus* has distinct arolia, whereas our *mundulus* has the paired setae. This is the only genus of the subfamily with such known variability.

In addition to the following two species, *C. lividipennis* Reuter was introduced by the Board of Agriculture and Forestry from Guam in 1939. It is a predator on the eggs of the corn leafhopper and is widespread in the Indo-Pacific. Unfortunately, that species has not become established here.

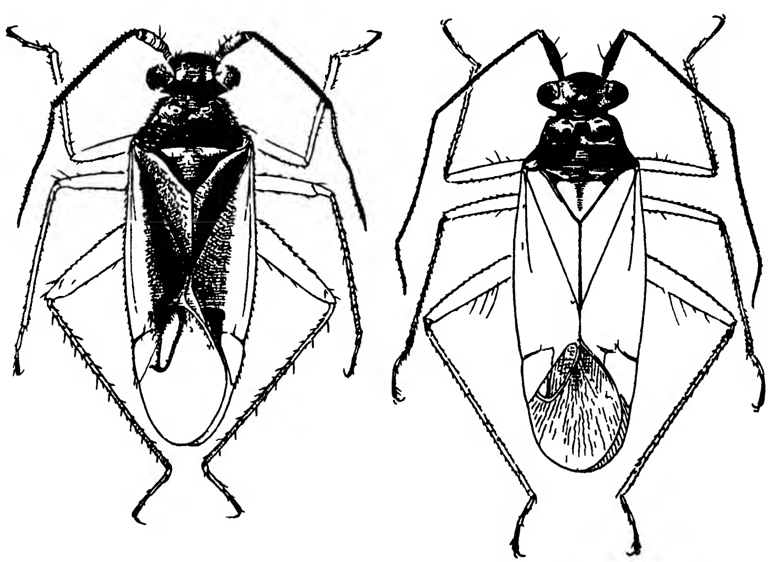


Figure 88—*Cyrtorhinus mundulus* (Breddin), the sugarcane leafhopper egg-sucking bug, left. *Cyrtorhinus fulvus* Knight, the taro leafhopper egg-sucking bug, right. (Drawn to same scale by Abernathy.)

Key to the Species of Cyrtorhinus Found in Hawaii

1. Head, thorax and abdomen mostly or entirely black; first antennal segment mostly yellow; fore wings in part fuscous, clavus almost black, outer wing edges pale, hyaline or subhyaline, closed wings appearing to be blackish down middle with whitish borders.................... **mundulus** (Breddin).
2. Head and prothorax mostly black, remainder of thorax and abdomen orange; scutellum orange with a black median line; first antennal segment mostly black; fore wings orange, conspicuously contrasting with black pronotum...... **fulvus** Knight.

Cyrtorhinus fulvus Knight (fig. 88).
Cyrtorhinus fulvus Knight, 1935:205.

Oahu.

The taro leafhopper egg-sucking bug.

Purposely introduced to Hawaii in 1938 for the purpose of aiding in the control of the taro leafhopper, *Tarophagus proserpina*. Recorded from Java, the Philippines, Fiji and Samoa. Fullaway sent the first specimens to Hawaii from the Philippines, and they were liberated in taro patches near Kaneohe, Oahu.

Cyrtorhinus mundulus (Breddin) (figs. 88; 89, a–d).
Periscopus mundulus Breddin, 1896:106; genotype of *Periscopus*

Kauai, Oahu, Molokai, Maui, Hawaii.
The sugarcane leafhopper egg-sucking bug.

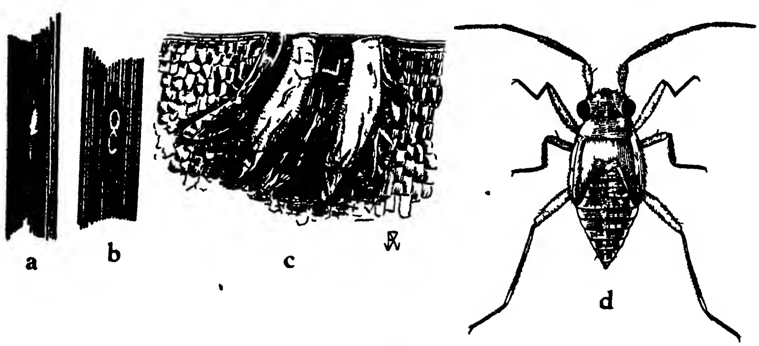


Figure 89—*Cyrtorhinus mundulus* (Breddin): **a**, an egg puncture of the sugarcane leafhopper in a sugarcane leaf; **b**, ends of two eggs of *Cyrtorhinus* protruding from an old leafhopper egg puncture; **c**, a section through the midrib of a sugarcane leaf to expose two unhatched *Cyrtorhinus* eggs inserted in a leafhopper egg slit among remnants of the leafhopper eggs; **d**, nymph. (a–c, after Williams, 1931.)

Purposely introduced from Queensland and Fiji in 1920 to aid in the control of the sugarcane leafhopper, *Perkinsiella saccharicida.* Known from Java (type locality), the Philippines, Australia and Fiji.

The introduction of this species, its subsequent successful establishment and the great good it has done is one of the most outstanding records in the history of biological control. This one bug has saved the Hawaiian sugar industry and the Territory millions of dollars—its true worth can hardly be estimated. Many people, I fear, have forgotten all too soon the ravages of the sugarcane leafhopper and how the failure of the sugar industry of the islands was averted by the successful control of the leafhopper by the concerted efforts of the faithful workers of the Experiment Station, H.S.P.A., at Honolulu.

An entire chapter could be devoted to the story surrounding this bug in Hawaii. There are those who were active during the establishment of control of the sugarcane leafhopper and who have already written excellent accounts. I can do no better here than to quote from Dr. Swezey's excellent report "Biological Control of the Sugar Cane Leafhopper in Hawaii" (1936:79–81) as follows:

> When in Queensland in 1920 in search of additional natural enemies for the sugar cane leafhopper, Dr. Muir discovered that the little mirid bug, *Cyrtorhinus mundulus,* had the habit of piercing and sucking leafhopper eggs, and was the most efficient control agent of that pest. Although belonging to a family of bugs which are chiefly plant feeders, it seemed never to suck plant tissues. A small colony of the bugs was brought to Honolulu, and later in the year larger consignments were obtained and sent from Fiji by C. E. Pemberton. The bug had previously been known by Dr. Muir in Fiji cane fields without his having learned its habits. Three consignments were received from Fiji in September, October, and November 1920, and consisted of adults and young in cages with growing cane and leafhoppers. Several hundreds of the bugs were received in this manner. Some were released in plantation fields infested with leafhoppers, others were used for breeding in cages; breeding was kept up for a year. From the breeding cages many hundreds of bugs were obtained for distribution to the regions where the leafhoppers were most abundant. The bug readily became established in these places and spread from them throughout the entire sugar cane area and even reached Maui and Molokai without assistance. The first recovery was at Olaa only a month after liberation (their eggs were found in leafhopper-infested cane leaves sent in for examination). During the following year (1921) a few scattering recoveries were made and it seemed doubtful if the bug were becoming established sufficiently to be of any importance. In March 1922, the bugs were found very abundant at Ewa Plantation, at Waialua and at Olaa. During the year it was found sparsely in many regions, and during 1923 was found to be generally distributed throughout all the cane regions. The leafhopper was now almost entirely reduced, this bug proving to be more efficient in destroying the leafhopper eggs than were the egg parasites. In fact, without doubt, *Cyrtorhinus* caused a reduction in the efficiency of the egg parasites for it sucked leafhopper eggs regardless of whether they were already parasitized or not. In a few more years, with the scarcity of the leafhoppers, it became difficult to find the egg parasites in the fields or parasitized leafhopper eggs. At this time (from 1923 on) the control of the leafhopper was considered to be complete, having finally reached this condition through the introduction and establishment of the *Cyrtorhinus,* which had increased to great abundance wherever there were leafhopper eggs. As outbreaks of leafhoppers were reduced by the *Cyrtorhinus,* the latter disappeared also, to appear again and increase to abundance wherever any new outbreaks of leafhopper occurred. It was considered by the entomologists that if this had been the first to be introduced, it would by itself have been sufficient for the control of the leafhopper....

Their favorite habitat is within the spindle of the cane plant and when very numerous they were also found among the bristles of the leafsheath. Under favorable conditions *Cyrtorhinus* may produce ten generations per year.

Dr. Williams (1931:103–104) includes the following descriptive information in his discussion of the species:

The adult Cyrtorhinus is about 3 millimeters long; the general color is black, with the body in part (beneath the wings) reddish in males and in all young adults, the legs and the base of the antennae are pale and the light smoky wings have a broad whitish front border. It seeks the eggs of the leafhopper and sucks them through a minute puncture which it makes with its slender beak. Wary and exceedingly active, it is usually approachable only with caution, otherwise it will dodge behind a leaf or stem or make a hasty flight to the next plant. The eggs are inserted into small crevices in the cane leaf, a leafhopper egg-slit being frequently chosen; they are of shorter and stouter form than those of the leafhopper and occur singly or in very small groups. Rather close scrutiny is required for their discovery, when they may be recognized, where they are exposed, flush with the surface of the leaf, as rather evenly oval white discs or caps, the center of which is sunken and dark giving them a ring-like appearance in contrast to the irregularly protruding, waxy covering that protects the tips of the leafhopper eggs. The young Cyrtorhinus are rather short, and bright red and suggest somewhat red spiders or mites of the genus Trombidium; they may often be seen in and about the spindles of the sugar cane plant, under favorable conditions, to the number of 50 or more; they are brisk runners and undoubtedly suck dry many a leafhopper egg apiece. In the last moult the vivid coloration disappears and the duller, fully winged adult now appears.

Genus **ORTHOTYLUS** Fieber, 1858

Tichorhinus Fieber, 1858.
Genotype: *Cimex nassatus* Fabricius, fixed by Kirkaldy, 1906.

This nearly cosmopolitan genus contains a larger number of described species in Hawaii than any other genus of local mirids. There are, however, many new species awaiting description in our collections. It would not be surprising to me to see 50 or more species described in this genus. Careful collecting and revisional study may show that this group rivals the *Nysius* complex in its diversification and development. The species are small, soft and delicate. Many of them are brightly colored and have striking color patterns. Some are brilliant green, others are bright red, some are conspicuously maculate, while others are somber in color with obscure markings. They closely resemble members of the genus *Psallus,* and one *Psallus* has been described in this genus. However, the genera belong to different subfamilies, as outlined in the key. *Orthotylus* has the tarsal arolia convergent, finger-like or flap-like, whereas these structures are wanting or indistinct in *Psallus.*

I have taken several species at light in the native forests. Perkins (1913:ccii) noted that "The nymphs are often abundant on the under side of the leaves of the trees, in company with the adults. Unless disturbed by shaking, very rarely are any of the latter seen on the wing." Native plants occasionally swarm with them.

The following preliminary key has been expanded from Kirkaldy's key (1920: 132–133), and with the aid of Dr. Usinger, who worked on it during a visit to my office in 1943, and of Mr. China, who checked it with the types at the British Museum and made some valuable changes and additions. It is based upon color for want of knowledge of the other characters of the group. The male genitalia display excellent differential characters, but insufficient authentically determined material has been at hand to enable us to use those structures here. It need hardly be mentioned further that this large, complex group is too poorly known at present for us to more than indicate what has been done and to suggest what remains to be done.

Key to the Hawaiian Orthotylus

1. Color largely reddish 2
   Color largely greenish, yellowish testaceous or fuscous (sometimes with a slight reddish tinge, but never distinctly red) 3

2(1). Cuneus entirely red, pale only along fracture..**kekele** Kirkaldy.
   Cuneus broadly white at base and narrowly so at apex.. **daphne** Kirkaldy.

3(1). Uniformly greenish or testaceous, immaculate............. 4
   Always more or less infuscated......................... 5

4(3). Pale green; pubescence entirely pale..........**iolani** Kirkaldy.
   Bluish green; pubescence brownish........**perkinsi** Kirkaldy.

5(3). Pronotum pallid testaceous (sometimes speckled with red anteriorly), with a distinct, dark brown, triangular mark in middle, its base along posterior margin and its apex just extending onto base of vertex of head... **azalais** Kirkaldy.
   Pronotum without such a fuscous mark.................. 6

6(5). Head, pronotum and inner apices of coria immaculate.......................................**tantali** (Perkins).
   Head, pronotum and inner apices of corium with fuscous markings 7

7(6). Cuneus with a dark red band across apical half leaving extreme apex and basal half pale pink; apical margin of corium surrounding cuneus pale pink; veins of membrane red; pronotum in female largely blackish...**kassandra** (Kirkaldy).
   Cuneus uniformly pale (female) or with only an apical marginal infuscation (male) which is sometimes reddish; veins of membrane brown; pronotum of female with a large, pallid, median, anterior area.....**kanakanus** Kirkaldy.

The hostplant lists are obviously incomplete, and I feel that some of them may be inaccurate because of misidentification of the bugs.

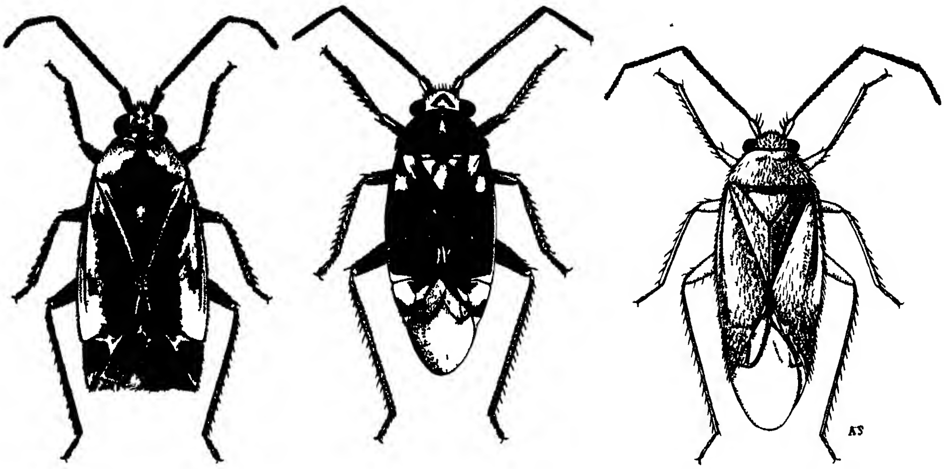


Figure 90—Holotypes of *Orthotylus azalais* Kirkaldy, left; *O. daphne* Kirkaldy, middle; *O. iolani* Kirkaldy, right. (Drawn at the British Museum of Natural History by Smith.)

Orthotylus azalais Kirkaldy (fig. 90).
Orthotylus azalais Kirkaldy, 1902:136, pl. 5, fig. 26.

Endemic. Kauai (type locality: Makaweli, 2,000 feet; Kirkaldy, 1908:198).
Hostplants: *Coprosma, Gouldia.*
The males and females differ in color pattern. The damaged type, figured here, is in the British Museum.

Orthotylus daphne Kirkaldy (fig. 90).
Orthotylus daphne Kirkaldy, 1902:135, pl. 5, fig. 24.
Tichorhinus daphne (Kirkaldy) Kirkaldy, 1908:198.

Endemic. Oahu (type locality: Waianae; Kirkaldy, 1908:198).
Hostplant: *Xylosma.*
The type is in the British Museum and is figured here.

Orthotylus iolani Kirkaldy (fig. 90).
Orthotylus iolani Kirkaldy, 1902:133.
Tichorhinus iolani (Kirkaldy) Kirkaldy, 1908:197.

Endemic. Oahu, Maui, Hawaii (type locality: Kilauea; Kirkaldy, 1908:197).
Hostplants: *Clermontia, Hibiscus, Pipturus albidus* (sometimes and in some places abundant on the leaves), *Sophora.*
Our figure was made from the type at the British Museum.

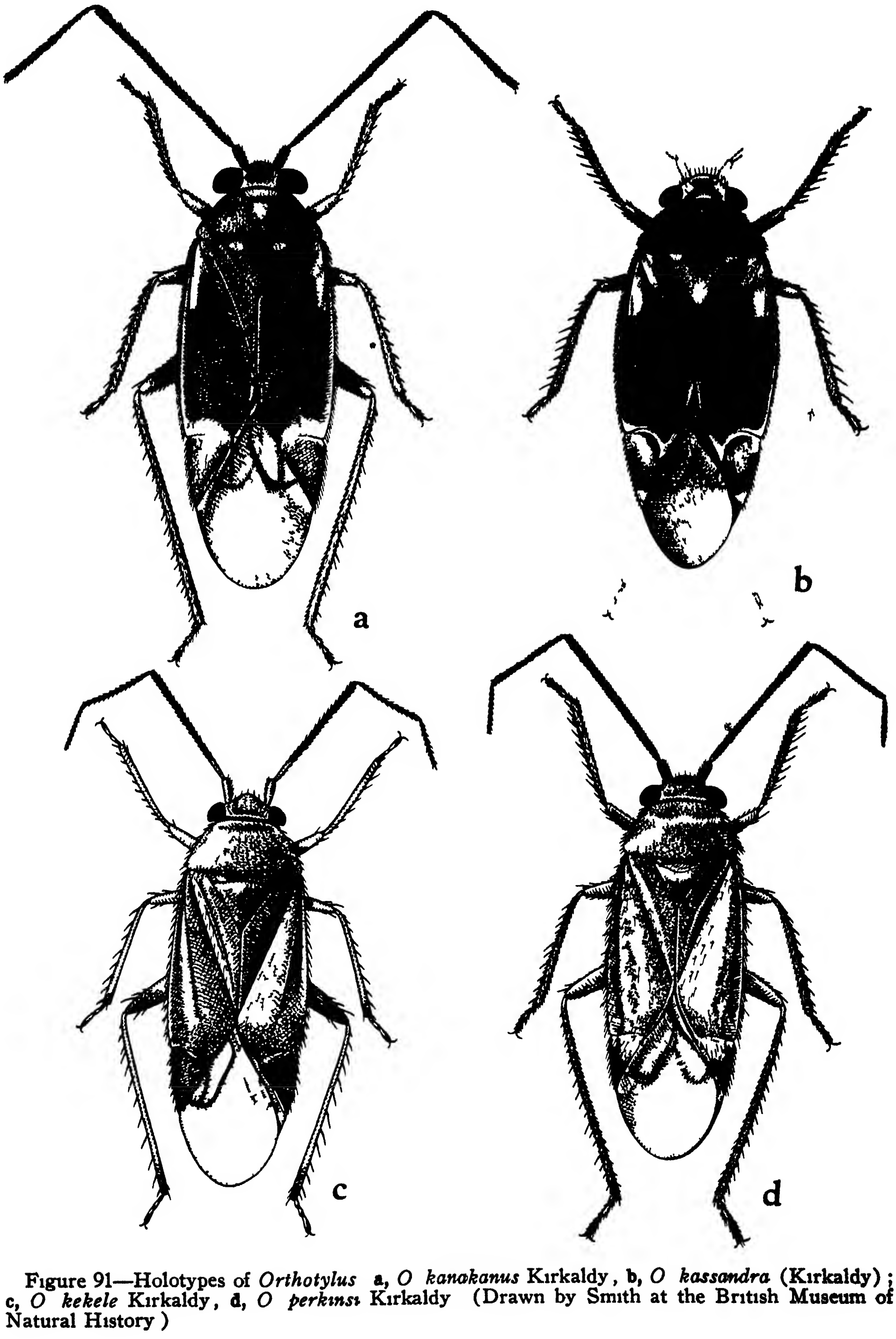


Figure 91—Holotypes of *Orthotylus* **a,** *O kanakanus* Kirkaldy, **b,** *O kassandra* (Kirkaldy); **c,** *O kekele* Kirkaldy, **d,** *O perkinsi* Kirkaldy (Drawn by Smith at the British Museum of Natural History)

Orthotylus kanakanus Kirkaldy (fig. 91, a).
Orthotylus kanakanus Kirkaldy, 1902:134, pl. 5, fig. 27.
Tichorhinus kanakanus (Kirkaldy) Kirkaldy, 1908:198.

Endemic. Oahu, Lanai, Maui, Hawaii (type locality: Kilauea; Kirkaldy, 1908:198).

Hostplants: *Pipturus albidus, Straussia.*

Mr. China reports that the type male (figured here) and cotype female under this name at the British Museum are teneral specimens, but that Kirkaldy had labeled the mature examples "*persephone*," a name he did not publish. There is sexual dimorphism in color in this species.

Orthotylus kassandra (Kirkaldy) (fig. 91, b).
Orthotylus daphne variety *kassandra* Kirkaldy, 1902:135, pl. 5, fig. 25.
Tichorhinus kassandra (Kirkaldy) Kirkaldy, 1908:198.

Endemic. Kauai, Oahu, Molokai, Lanai, Hawaii (type locality: Kilauea; Kirkaldy, 1908:198).

Hostplants: *Acacia koa, Alyxia, Ipomoea, Sadleria, Straussia, Pipturus.*

The British Museum type is illustrated here.

Orthotylus kekele Kirkaldy (fig. 91, c).
Orthotylus kekele Kirkaldy, 1902:134, pl. 5, fig. 28.
Tichorhinus kassandra (Kirkaldy) Kirkaldy, 1908:198.

Endemic. Kauai (type locality: "High Plateau")

Hostplants: *Broussaisia, Pipturus.*

The type is in the British Museum and is figured here.

Orthotylus perkinsi Kirkaldy (fig. 91, d).
Orthotylus perkinsi Kirkaldy, 1902:133.
Tichorhinus perkinsi (Kirkaldy) Kirkaldy, 1908:197.

Endemic. Kauai, Oahu, Lanai, Maui, Hawaii (type locality: Kilauea; Kirkaldy, 1908:197).

Hostplant: *Sophora.*

Our illustration was made from the type in the British Museum.

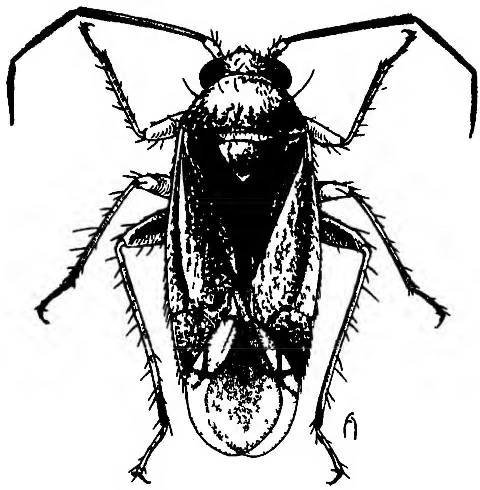


Figure 92—*Orthotylus tantali* (Perkins). (Drawing by Abernathy.)

Orthotylus tantali (Perkins), new combination (fig. 92).
Tichorhinus tantali Perkins, 1912:730, fig. *B*.

Endemic. Oahu (type locality: Mount Tantalus).
Hostplant: *Pipturus* (abundant at times).
The type is in the Bishop Museum.

Genus **KAMEHAMEHA** Kirkaldy, 1902:137

In our fauna, this native genus appears to include a large *Orthotylus* but the rostrum extends beyond the metacoxae, and the median line of the head is impressed. It closely resembles the large, widespread genus *Phytocoris*. It is, of course, named after the great Hawaiian, King Kamehameha I. Additional species will perhaps be discovered and described in this genus.

Kamehameha lunalilo Kirkaldy (fig. 93).
Kamehameha lunalilo Kirkaldy, 1902:137, pl. 5, fig. 22. Genotype.

Endemic. Oahu (type locality: Waianae; Kirkaldy, 1908:198).
Hostplants: *Cyrtandra, Pipturus*.
This species, named in honor of King Lunalilo, is a rather striking member of our Miridae. It is mottled and spotted, principally with browns, yellows and reds when dried, and the legs and antennae are long. The hemelytral membrane extends beyond the apex of the abdomen for a distance greater than the length of the venter behind the metacoxae.

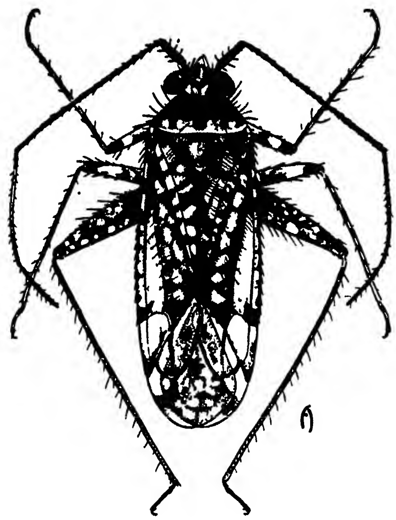


Figure 93—*Kamehameha lunalilo* Kirkaldy. (Abernathy drawing.)

It is "chiefly to be found in damp forests, living on the mosses or creeping ferns, which clothe the trunks and branches in such situations. Consequently it may be obtained from many kinds of trees by indiscriminate beating of the branches." (Perkins, 1913:ccii.)

Genus **KOANOA** Kirkaldy, 1902:136

The two species thus far described in this native genus somewhat resemble convex, black, submetallic *Orthotylus*. However, they differ from *Orthotylus* by having the second antennal segment much shorter and not passing the hind pronotal margin (it far surpasses the hind margin in *Orthotylus*), by having a short rostrum which does not extend onto the apices of the mesocoxae, and by having the outer edge of the hemelytral fracture comparatively deeply and conspicuously emarginate. They also vaguely suggest small species of *Sarona*. The longitudinal dorsal contour is unusual, as the illustration shows. There are several new species before me. Mr. China tells me that he feels that the genus is "far from being a typical Heterotomid."

Key to the Species of Koanoa

1. Second antennal segment concolorous, entirely yellowish; setae on disc of pronotum and hemelytra comparatively appressed and shorter and of different type than those of second antennal segment........................**hawaiiensis** Kirkaldy.
2. Second antennal segment partially (female) or entirely (male) black; setae on disc of pronotum and hemelytra long and about as long as those on second antennal segment, those on pronotum and scutellum comparatively erect, bristling..... ....**williamsi** Usinger.

Koanoa hawaiiensis Kirkaldy (fig. 94).
Koanoa hawaiiensis Kirkaldy, 1902:136.

Endemic. Kauai, Oahu, Molokai, Lanai (type locality: Kirkaldy, 1908:198), Maui, Hawaii.

Hostplants: *Acacia koa, Bidens cosmoides, Cheirodendron, Metrosideros, Sideroxylon, Styphelia* (*Cyathodes*).

The above distribution follows Kirkaldy, but there is reason to believe that more than one species was included in his type series.

Koanoa williamsi Usinger (fig. 94).
Koanoa williamsi Usinger, 1937:437.

Endemic. Oahu (type locality: Mount Lanihuli).

Hostplant: *Freycinetia* (not uncommon "...between and at the bases of the clasping leaves particularly toward the top of the leaf cluster where the youngest and tenderest foliage is to be found." Usinger, 1937:437).

Usinger described the first, second, fourth and fifth nymphal instars.

Subfamily MIRINAE (Reuter, 1910)

Two genera represent this subfamily in Hawaii. They are our most elongate native Miridae and are easily recognized. The two Hawaiian groups are easily distinguished as follows:

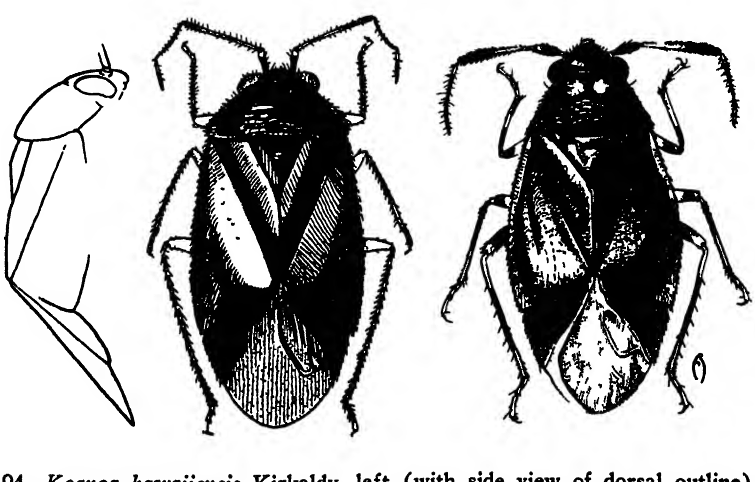


Figure 94—*Koanoa hawaiiensis* Kirkaldy, left (with side view of dorsal outline). *Koanoa williamsi* Usinger, left. (Abernathy drawings.)

1. Head porrect, more or less cone-shaped, elongate............ .... **Oronomiris** Kirkaldy.
2. Head deflexed, broad.....................**Nesiomiris** Kirkaldy.

Genus ORONOMIRIS Kirkaldy, 1902:144

In addition to the single described species, there are new species before us, some of which are peculiar brachypterous forms. They resemble closely the wide-spread genus *Trigonotylus* Fieber. The only Hawaiian group with which they might possibly be associated after a cursory glance is *Nesiomiris,* because of similar size and their elongate, slender bodies. Their heads, however, are peculiar, porrect, rather cone-shaped, the eyes are not strongly protuberant and hardly extend beyond the sides of the front of the pronotum, the tylus is peculiarly and strongly produced and compressed.

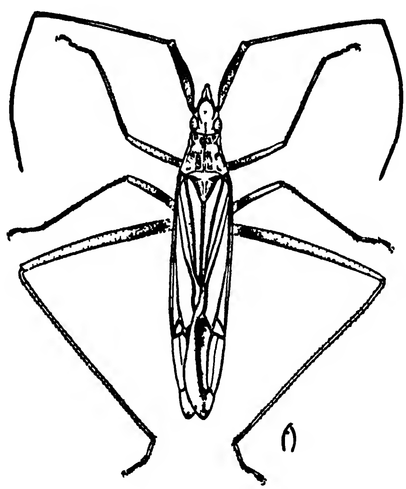


Figure 95—*Oronomiris hawaiiensis* Kirkaldy. (Abernathy drawing.)

Oronomiris hawaiiensis Kirkaldy (fig. 95).

Oronomiris hawaiiensis Kirkaldy, 1902:144, pl. 5, fig. 30. Genotype.

Endemic. Kauai, Oahu (type locality: Waimea; Kirkaldy, 1908:198), Lanai, Maui, Hawaii, Laysan.

Hostplants: native grasses (abundant at times), Bermuda grass, *Sporobolus virginicus.*

Perkins (1913:cc–cci) stated that he found it to be "a very abundant species on foreign grasses, [and it] occurs everywhere in suitable places, from the coast to 5000 ft. or more in the higher islands. This will, I think, almost certainly be found

outside the islands though possibly a natural immigrant." The discovery of new species of the genus now places this species on the endemic list, however, and I feel that there is a mixture of species in the series from which the above data have been derived.

Genus **NESIOMIRIS** Kirkaldy, 1902:144

This endemic genus is allied to the widespread *Teratocoris* Fieber. Although only the genotype has been described, there has been assembled in local collections a whole series of splendid new species which now await description. Perhaps several dozen species will eventually be discovered. The male genitalia display remarkable structural differences. The group contains some of our largest Miridae, and they are readily recognized by their comparatively large size and their slender, elongate forms. The species are mostly green, drying to yellows and pale browns. I have examined specimens from all of the main islands.

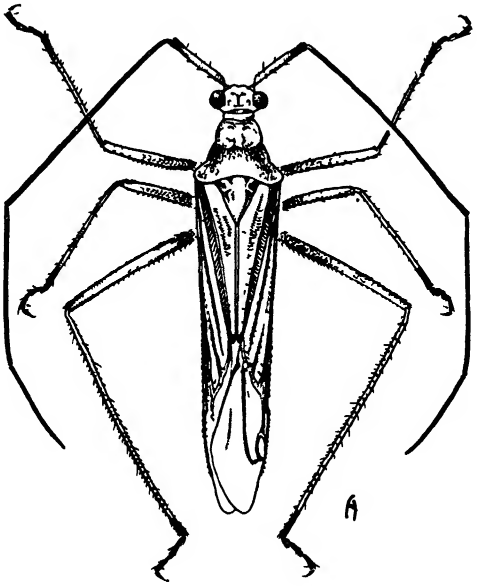


Figure 96—*Nesiomiris hawaiiensis* Kirkaldy. (Abernathy drawing.)

Nesiomiris hawaiiensis Kirkaldy (fig. 96).
Nesiomiris hawaiiensis Kirkaldy, 1902:145, pl. 5, fig. 50. Genotype.

Endemic. Hawaii (type locality: Olaa; type labeled *N. kekele* in error, Kirkaldy, 1908:198).

Hostplants: *Byronia, Cheirodendron gaudichaudi, Reynoldsia, Tetraplasandra hawaiiensis*. There may be errors in this list because of misidentifications of the bugs.

It is probable that the type series contained more than one species, and although the species has been recorded from Oahu, Molokai, Lanai and Maui, I believe that it may be confined to Hawaii.

Subfamily CAPSINAE (Reuter, 1883)

The combination of conspicuously collared prothorax, strongly divergent tarsal arolia and hemelytral cell divided into two areoles suffices to separate this group from all others in Hawaii.

Key to the Genera of Capsinae Found in Hawaii

1. Fore wings for most part transparent, hind wings and abdomen distinctly visible through them; clavus and corium mostly without coarse punctures and with fine setae confined mostly to margins; antennae nearly as long as body.. **Hyalopeplus** Stål.
2. Fore wings opaque; clavus and corium entirely covered with dense, rather coarse setiferous punctures; antennae only about one-half as long as body.................. **Lygus** Hahn.

Genus HYALOPEPLUS Stål, 1870

This genus is largely confined to the Indo-Pacific area but it extends to the Ethiopian region. It is abundantly represented in the southern and western Pacific islands.

Hyalopeplus pellucidus (Stål) (fig. 97).
Capsus pellucidus Stål, 1859:255.

Kauai, Oahu (type locality: Honolulu), Molokai, Lanai, Maui, Hawaii.

Immigrant. Also known from the Society Islands.

Hostplants: *Acacia koa*, coffee, *Coprosma, Dodonaea*, avocado (breeds in the inflorescence), guava, *Hibiscus* (the common host in the lowlands), *Metrosideros, Pipturus, Sida, Straussia*.

This is a common insect which ranges from the seashore to several thousands of feet into the mountains. It is occasionally collected about lights. It is our most bulky mirid, and reaches a length of 8 to 10 mm. Kirkaldy (1907:159) described the fourth and fifth stage nymphs. It is variable in color; some individuals are

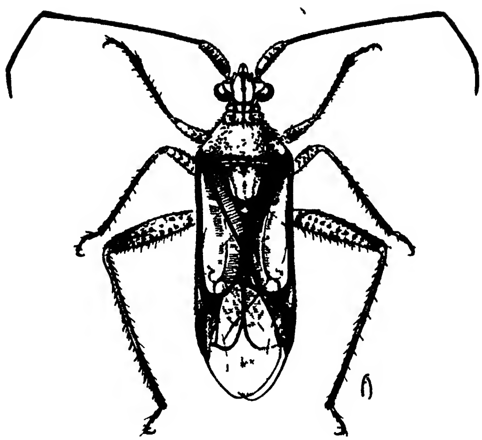


Figure 97—*Hyalopeplus pelucidus* (Stål). (Abernathy drawing.)

much darker than others. Kirkaldy (1904:185) noted that "It is predaceous and should not be destroyed." Its feeding habits are unknown, however, and some observers believe that it is phytophagous.

Genus LYGUS Hahn, 1831

This is a large, nearly world-wide, difficult-to-work-with genus. Although a number of species occur in the southwest Pacific and as near to Hawaii as Samoa, the genus has not reached Hawaii by natural means. A single American species, however, has recently been accidentally imported to our islands.

The genus is easily separated from all our other mirids by the characters summarized in the key to the genera and by the distinctive features of the subfamily. The convex, coarsely punctured dorsum might lead one to associate it with some of our Bryocorinae, but the presence of a collar on the pronotum is a conspicuous character for use in the easy separation of the two groups.

Lygus elisus (Van Duzee) (fig. 98).

Lygus pratensis variety *elisus* Van Duzee, 1914:20.

Lygus elisus (Van Duzee) Van Duzee, 1917:347. Knight, 1917:574, fig. 165 (genitalia). Shull, 1933:1–42, figs. 1–3.

The pale legume bug.

Immigrant. Described from California and widespread in western United States. First discovered in Hawaii in material taken in a light trap set up at Iroquois Point, Pearl Harbor, by Hawaiian Sugar Planters' Association entomologists in July, 1947.

Figure 98—*Lygus elisus* (Van Duzee), the pale legume bug.

Hostplant: *Chenopodium album.*

Although we have found it only on one hostplant in Hawaii, we expect it to attack a number of other plants here, and it may become a pest of considerable economic importance. Shull (1933) lists the following as hostplants in Idaho: *Amaranthus retroflexus, Beta vulgaris, Chenopodium album, Daucus carota, Medicago sativa, Melilotus albus, Phaseolus vulgaris, Plantago major, Polygonum aviculare, Pyrus malus, Rumex crispus, Salsola pestifer, Seratina pitcheri, Solanum nigrum, Trifolium pratense, Trifolium repens.*

Shull (1933) states that the injury to beans "appears as a small hole in the seed coat, which is surrounded by a yellow area. Beneath the seed coat in the yellowed area are granules of starchy material. This injury may be caused from the time the bean pods are about half grown until the seed coat toughens just before maturity. The feeding of the insects on the blossoms causes them to drop."

The species causes loss of seed in alfalfa. It is a pest of cotton in California. When feeding on sugarbeets, it has been reported to prey also upon the sugarbeet leafhopper. Baker and Snyder (1946:500) have reported that "the toxic feeding of Lygus bugs is responsible in the California Lima bean crop for a seed spotting and pitting, and for some of the dropping of blossoms and pods." They also note that the insects have been reported to be "highly toxicogenic," to cause "severe blossom drop in alfalfa and cotton" and to "reduce germination of beet seed." They include a bibliography of ten titles.

Family **SALDIDAE** (Amyot and Serville, 1843)

Saldides Amyot and Serville, 1843.
Acanthiidae Stephens, 1829.

The Shore Bugs

The saldids are a cosmopolitan group of predaceous bugs almost all of which frequent the edges of ponds, streams, lakes, waterfalls, marshes and other moist places. An English species is said to be found on sand hills and dry heaths. However, the Hawaiian species form a partial exception to the rule in that there are some partially arboreal forms here—the only known arboreal saldids. They are active runners and fliers and frequently are difficult to capture; most of them are good jumpers. The saldids are considered by some workers to form a connecting link between the terrestrial and the aquatic groups of Heteroptera.

Ovate, subdepressed species; head wider across the eyes than front of pronotum; eyes large, strongly protuberant; two ocelli situated between the eyes; rostrum three-segmented, held free from the lower side of the head and prosternum in repose, the first and third segments unusually short, the second segment extraordinarily long; antennae four-segmented; brachypterous or macropterous in the same species; hemelytra without a cuneus, membrane, when developed, with several long, closed cells; tarsi three-segmented, the first segment short, claws long and slender, arolia absent.

Subfamily SALDINAE Van Duzee, 1917:438

Acanthiinae Reuter, 1912.

Genus **SALDULA** Van Duzee, 1914:387

Genotype: *Cimex saltatorius* Linnaeus, fixed by Van Duzee, 1914.
Acanthia Latreille, 1897, not Fabricius, 1775.

Saldula commonly are found along the edges of streams or on oozing banks in the mountains, but some species also frequent the damp forest floor at a distance from stream sides. The arboreal forms frequent damp moss-, lichen- and liverwort-covered trees and shrubs in the rain forests, but are not confined to such habitats, for they may occur also on the ground. Usinger has made some observations on the life histories of some of the species, but he has not published his results yet. He fed them on young longhorned grasshoppers. Williams (1944: 187) has seen one species "probing algal covered boulders for the larvae of Tipulidae."

When Kirkaldy wrote his first (1902) contribution for *Fauna Hawaiiensis,* he recognized two species and five "varieties." Later (1908) he described three new species and a new subspecies. Unfortunately, Kirkaldy apparently did not have *exulans* or *oahuensis* properly identified, and Usinger has shown me that two of Kirkaldy's forms must be reduced to synonymy. There are new species in our collections.

Brachypterous and macropterous forms occur. The hind wings may be reduced to small flaps.

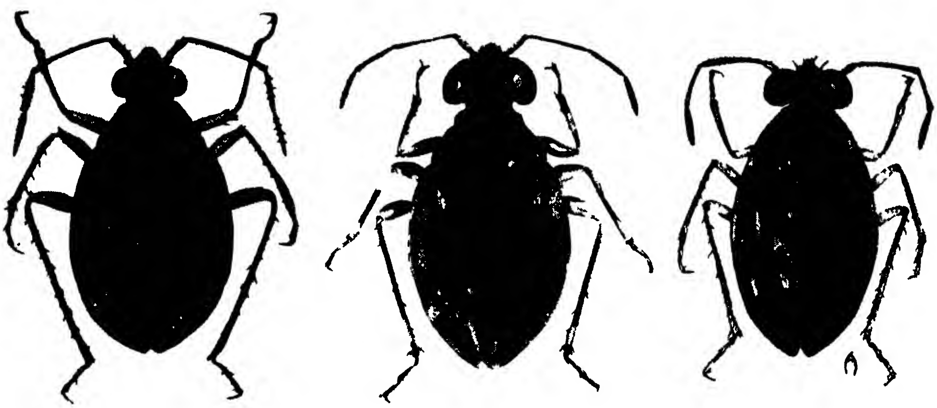


Figure 99—*Saldula exulans* (White), left. *Saldula oahuensis* (Blackburn), middle. *Saldula procellaris* (Kirkaldy), variety (?), right. (Abernathy drawings; not to same scale.)

Key to the Species of Hawaiian Saldula

1. Corial margins broadly explanate to well beyond middle; pubescence sparse, decumbent, body large (4.5 mm. or longer); head about two-thirds as broad as pronotum....**exulans** (White).
   Head more than two-thirds as broad as pronotum; pubescence usually dense, usually appressed; body small (less than 4 mm.); costal margins less expanded (compare illustrations)... 2
2. Second and fourth antennal segments subequal in length.... ....**nubigena** (Kirkaldy).
   Second antennal segment distinctly longer than fourth......... 3
3. Pubescence dense and appressed.........**oahuensis** (Blackburn).
   Pubescence sparse and decumbent.........**procellaris** (Kirkaldy).

Saldula exulans (White) (fig. 99).

Salda exulans White, 1878:373.

Acanthia exulans variety *molokaiensis* Kirkaldy, 1908:198 (type from Molokai Mountains). New synonym.

Saldula exulans (White) Van Duzee, 1936:229.

Endemic. Kauai(?), Oahu (type locality: "Sparingly in wet moss in one place on the mountains near the 'Pali' "), Molokai.

Saldula nubigena (Kirkaldy) (fig. 100).
Acanthia nubigena Kirkaldy, 1908:199.

Endemic. Maui (type locality: Mount Haleakala, 5,000 feet).
The type in the British Museum is figured here.

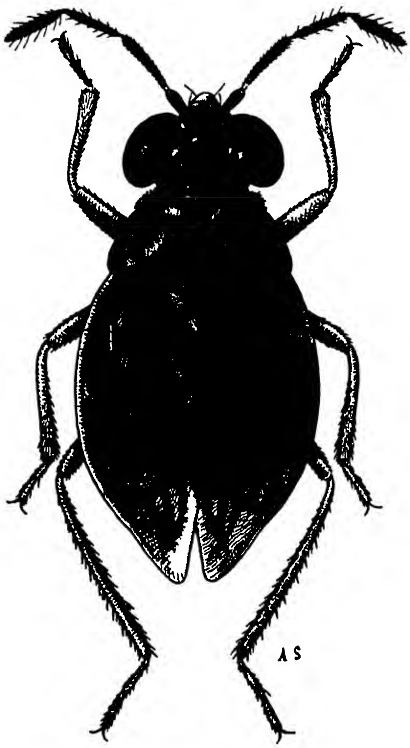


Figure 100—*Saldula nubigena* (Kirkaldy), holotype. (Drawn at the British Museum of Natural History by Smith.)

Saldula oahuensis (Blackburn) (fig. 99).
Salda Oahuensis Blackburn, 1888:353.
Saldula oahuensis (Blackburn) Van Duzee, 1936:229.
Acanthia humifera Kirkaldy, 1908:199 (type locality: northwest Koolau Mountains).
Saldula humifera (Kirkaldy) Van Duzee, 1936:229. New synonym.

Endemic. Kauai, Oahu (type locality: "Two specimens occurred near a waterfall several miles from Honolulu"), Molokai(?), Lanai, Maui, Hawaii.
This species has been found among wet leaves on the ground.

Kirkaldy did not know Blackburn's type (which is now in the Bishop Museum) and his *humifera* must fall as a synonym, according to Dr. Usingèr's advice.

The hind wings on the holotype are reduced to flaps shorter than the breadth of the head.

Saldula procellaris (Kirkaldy) (fig. 99).

Acanthia procellaris Kirkaldy, 1908:200.

Saldula procellaris (Kirkaldy) Van Duzee, 1936:229.

Endemic. Oahu, Molokai (type locality: 4,000 feet), Lanai(?), Maui.

Family HEBRIDAE (Amyot and Serville, 1843)

Naeogeidae Kirkaldy, 1902:168.

The Velvet Water Bugs

This is one of the smallest families of the Heteroptera. It includes small aquatic or subaquatic bugs which have the body largely clothed with short, dense pile. Eyes strongly protuberant, a pair of ocelli present (very small and placed near the inner hind corners of the eyes in our species); antennae short, not extending behind the pronotum, four-segmented in our species; rostrum four-segmented,

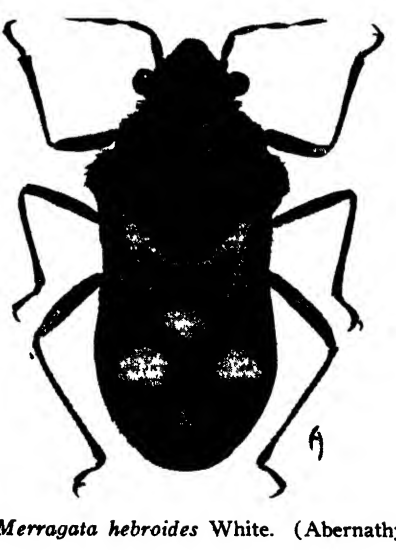


Figure 101—*Merragata hebroides* White. (Abernathy drawing.)

extending to between the metacoxae, base held within a groove on the underside of the head when in repose; hemelytra entire, without a cuneus, the membrane large, without veins; legs short and slender, coxae well-separated, tarsi two-segmented, with arolia, claws paired, long, terminal.

One immigrant species represents the family in our islands.

Genus **MERRAGATA** White, 1877:113

This is an American genus of few species.

Merragata hebroides White (fig. 101).
Merragata hebroides White, 1877:114. Genotype.

Oahu (type locality).

Immigrant. A widespread North American species.

This pretty little macropterous, predaceous bug walks about on the surface of ponds, streams and puddles, and readily submerges to explore submerged vegetation. It can stay underwater for a considerable length of time. Its life history should be worked out in detail.

Blackburn's field notes (as recorded by White, 1878:366) read as follows: "On small stagnant pools formed by the temporary overflow of streams on the higher mountains. When the pools dry up, the insect frequents the holes where the water has been."

Williams (1944:188, fig. 9) gives the following account:

> This is a compact little bug about 2 mm. long. It is rather leisurely, even tedious in its movements, and its short water-skimming flights do not suggest much energy. *Merragata* is a common insect at puddles, along stagnant portions of streams and in reservoirs, occurring there on algae and algal blankets. Both young and mature bugs readily pull themselves under water, where they become conspicuous because of their air-silvered bodies.... In the laboratory one was seen sucking the juices of an immature one of its own kind that still showed signs of life. And here it was preyed upon by *Mesovelia vagans* [error for *mulsanti* in text]....

Family **MESOVELIIDAE** Reuter, 1910

The Water Treaders

The mesoveliids constitute another small family of small, velvety, subaquatic bugs. Eyes large, protuberant, basal, the pair of ocelli subbasal and placed near the median line (obsolete in the apterous forms); antennae slender, four-segmented, reaching to behind the scutellum; rostrum not held against the head at repose,

three-segmented, segment two much longer than one plus three, exceeding the mesocoxae; hemelytra present or absent or brachypterous, corium long, with prominent veins, clavus membranous and membrane without veins in our species; legs long and slender, metacoxae contiguous, tarsi three-segmented, first segment very small, claws paired, slender, terminal, arolia absent.

The family contains only two genera.

Genus MESOVELIA Mulsant and Rey, 1852

Genotype: *Mesovelia furcata* Mulsant and Rey, the only species included by the authors.

These bugs run upon the surface of the water instead of swimming.

Mesovelia mulsanti White (figs. 102, 103).

Mesovelia Mulsanti White, 1879:268.

Hungerford, 1919:100–105, illustrated; gives a detailed account of this species, including its life history. Usinger, 1942:177, notes.

Kauai, Oahu, Molokai.

Immigrant. Widespread in North and South America. First found in the Territory by Williams at Waipio, Oahu, in 1933.

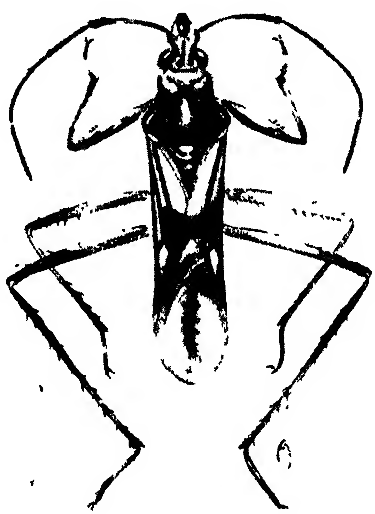


Figure 102—*Mesovelia mulsanti* White. (Abernathy drawing.)

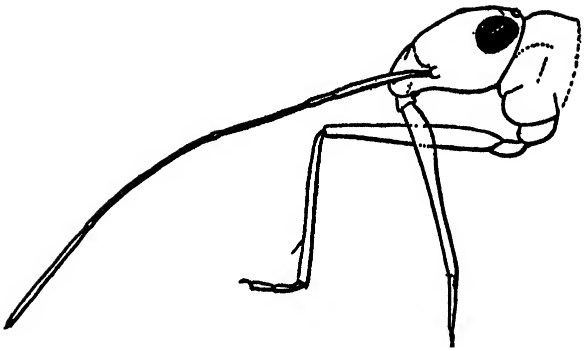


Figure 103—*Mesovelia mulsanti* White, profile of head to show the strong beak of this predaceous bug. (After Williams, 1944.)

This long-faced bug is now widespread, especially in lowland reservoirs, ponds, taro patches and such places, but it also ventures into the mountains in some areas. It frequents masses of algae and floating or partially submerged vegetation and moves over the water surface with great agility. The eggs are inserted in plant tissue. Both long- and short-winged forms occur. It is a fierce predator and feeds on many kinds of insects which venture near enough for it to grasp. Williams (1944:189–190, figs. 11–13) found that it fed on *Merragata hebroides* in captivity. It "often pounced upon a young *Merragata,* sometimes holding it down with aid of a foot or grasping it loosely with the legs and probing it for a deadly thrust. Or, *Mesovelia* would use only its beak for the attack. The thrust was sometimes made in a leg joint and sometimes in the body itself; in any case *Merragata* collapsed almost immediately, folding up its legs. It would then be held aloft to be sucked of its juices."

Family **VELIIDAE** Douglas and Scott, 1865

The Smaller Water Striders

A single immigrant species is our only representative of this small family of small, semi-aquatic bugs. Eyes comparatively large, protuberant, basal, ocelli obsolete; antennae four-segmented, not reaching apex of pronotum; rostrum received in a groove on the underside of the head, reaching only to behind fore coxae, four-segmented, third segment longer than the others combined (segment two small and sometimes difficult to see); pronotum and mesonotum fused, scutellum nearly or entirely hidden (in winged form); macropterous, brachypterous or hemelytra absent, when present entirely membranous and with conspicuous veins; legs comparatively short, all coxae separated, hind femora not extending beyond apex of abdomen in our species, fore tarsi two-segmented, mid and hind pairs three-segmented with the basal segment small in our species, claws preapical, paired, arolia wanting.

Genus MICROVELIA Westwood, 1834

Genotype: *Velia pygmaea* Dufour, fixed by Westwood, 1840.

A cosmopolitan genus containing a fairly large number of species.

Microvelia vagans White (fig. 104).
Microvelia vagans White, 1878:374.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii.
Immigrant(?). Source undetermined. Described from the Territory, but no type locality given by White.

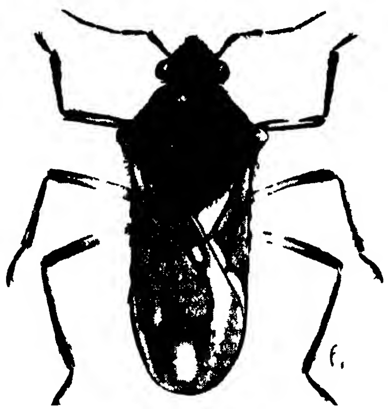


Figure 104—*Microvelia vagans* White. (Drawing by Abernathy.)

This is a common predaceous water bug from sea level to about 7,000 feet. It is found among such water plants as duckweed (*Lemna*) and inhabits ponds, puddles and running water. It is attracted to lights at night. Williams (1944: 192–193, fig. 10) gives the following noteworthy account:

It measures about 2.3 mm. long and is represented by both apterous and winged forms. It can be found on stagnant pools, taro ponds, lily ponds, the edges of sluggish streams where there is plenty of algal growth, and even in street gutters in wet districts. It will also find its way into tanks and other large water containers. It is not always on the surface of the water but patronizes the wet leaves and rocks nearby. A fiercely predaceous insect, *Microvelia* gangs up on chironomid flies as these emerge from their pupae at the surface of the water, and may overcome crane-flies issuing from some moss or algal growth. In the cool Mountainview region of the island of Hawaii, in October 1933, I witnessed successful attacks by *Microvelia* on the large, pale, dark spotted collembolan, probably *Salina*, that so often finds its way into pools with steep banks. *Salina* is an active leaper upon the surface of the water, nevertheless the bug succeeds in stabbing it in the back, or it would rush at it from the side. Once stabbed, *Salina* immediately collapsed. The presence in this pool of many dead and sucked-out *Salina* attested to the success of *Microvelia*.

Microvelia lays her eggs on dead leaves in pools, or elsewhere in the wet. The tiny red young may show silvery bubbles of air within the body, and a recently hatched individual clinging submerged to a leaf was observed with its proboscis at the surface, adding bubbles to its supply.

Family **GERRIDAE** (Leach, 1815) Dohrn, 1859

The Water Striders

All of the continents and most of the high islands of the world have fresh-water representatives of this group of water bugs. Hawaii has no fresh-water forms, but it does have two marine species.

Body densely clothed with velvety pile; eyes large, protuberant; ocelli postero-lateral, obsolescent in our species; antennae longer than head and pronotum, four-segmented; rostrum very short in our species, not surpassing fore coxae, obscurely four-segmented, the third segment longer than the others combined; pronotum shorter than head in our forms, scutellum and hemelytra wanting in our species; legs very long and slender, coxae well separated, tarsi two-segmented, claws pre-apical, paired, arolia absent.

Genus **HALOBATES** Eschscholtz, 1822:106

This is a remarkable and fascinating group of insects. Twenty-five species have been described, but other new species from the Pacific are known to us. They are not only morphologically peculiar, but they lead an entirely marine or even pelagic life. Little is known of their habits, but they are predaceous. I have thrown small objects into the sea where *Halobates* were swimming and have had them rush to and grasp the objects with great speed and facility. They probably prey upon a variety of small animals such as Crustacea. Those frequenting shoreside waters might also feed upon insects which are blown or fall into the sea. Usinger (1938: 77–84) found them to be "fiercely cannibalistic."

The head is broader across the eyes than the prothorax, which is reduced and is smaller than the head. The mesonotum is the largest part of the body, the abdomen is reduced, and the hind legs are peculiarly placed above the middle pair. None has wings.

Usinger (1938) gives a checklist of the species of the genus and a bibliography.

Key to the Hawaiian Halobates

1. Second antennal segment only slightly more than one-half as long as fourth; first segment of fore tarsus less than one-half length of second; ventrites without yellow coloring.. **sericeus** Eschscholtz.
2. Second antennal segment almost as long as or longer than fourth; first segment of fore tarsus only slightly shorter than second; ventrites, excluding genital capsule, mostly yellowish .... **hawaiiensis** Usinger.

Halobates hawaiiensis Usinger (fig. 105).

Halobates hawaiiensis Usinger, 1938:79, figs. 1–3.

Hawaiian pelagic water strider.

Endemic. Oahu (type locality: Waikiki, Honolulu).

This species is abundant along certain shores of Oahu.

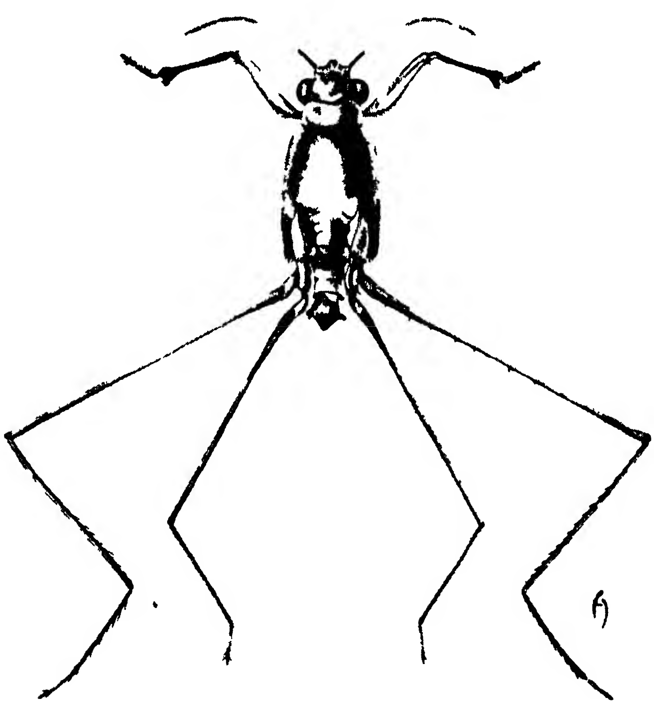


Figure 105—*Halobates hawaiiensis* Usinger, paratype, the Hawaiian pelagic water strider. (Abernathy drawing.)

Halobates sericeus Eschscholtz (fig. 106).

Halobates sericeus Eschscholtz, 1822:108, pl. 2, fig. 4.

Hadden, 1931:457–459, discussion.

Pelagic water strider.

Indigenous. Recorded from waters surrounding Oahu, Maui and Kahoolawe, but probably around all of the islands. Also found on Johnston Island. It is evidently a tropicopolitan species and has been found at sea far from land. It is driven ashore at times of storm.

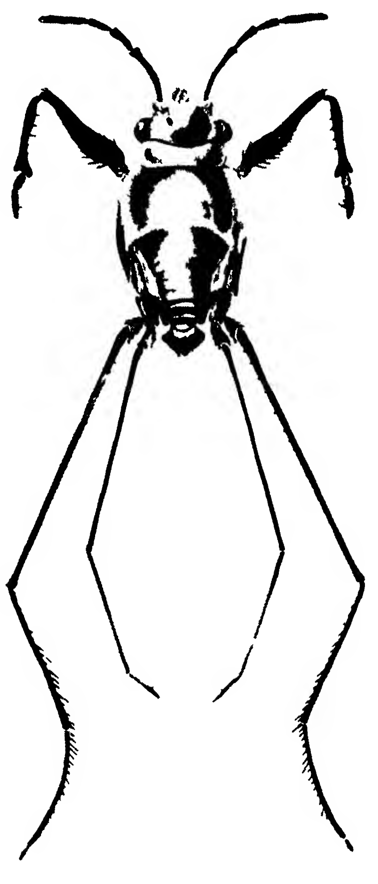


Figure 106—*Halobates sericeus* Eschscholtz, pelagic water strider. (Abernathy drawing.)

Series II—CRYPTOCERATA Fieber, 1851

This series, which elsewhere includes the aquatic families Gelastocoridae, Naucoridae, Nepidae, Belastomidae, Notonectidae and Corixidae, is not represented in the native Hawaiian fauna. We have here only a single immigrant representative of each of the two last-mentioned families.

The antennae, instead of being free and elongate, are short and hidden under the edges of the eyes.

Family **NOTONECTIDAE** (Leach, 1815) Samouelle, 1819

The Back-Swimmers

These peculiar bugs obtain their common name from the fact that they actually swim on their backs. Their dorsal surfaces are convex and shaped like the hull of a boat. They are truly aquatic, and they dive and swim well under water. Our species has the eyes very large, the inter-ocular space narrow; ocelli absent; antennae three-segmented, small and concealed from above beneath the edges of the eyes; rostrum short, stout, three-segmented, not surpassing fore coxae; scutellum broad, well-developed; hemelytra of similar texture throughout, without distinct veins; coxae contiguous or nearly so, mesocoxae lying in long sternal grooves in our species, hind legs longest, their tibiae and tarsi fringed; tarsi two-segmented, claws paired on fore and mid pair, absent on hind pair.

Genus **BUENOA** Kirkaldy, 1904

This is an American genus. The hemelytra are partially transparent.

Buenoa pallipes (Fabricius) (fig. 107, 108).

Notonecta pallipes Fabricius, 1803:103.

Buenoa pallipes (Fabricius) Kirkaldy, 1904:123.

Immigrant. An American species first collected in the Territory by Perkins about 1900.

This species is abundant in the lowlands, although it does extend its range to a few thousand feet elevation, and it flies actively. It is a voracious feeder on

Figure 107—*Buenoa pallipes* (Fabricius), a back swimmer. (Abernathy drawing.)

almost all kinds of insects, including mosquito wrigglers, which it can capture and hold with its stout fore legs. It also feeds upon Crustacea. The males stridulate freely by rubbing a striated area on the innersides of the fore femora and tibia against the specialized base of the rostrum. Mating takes place under water. The eggs are inserted in the submerged tissues of plants. It can give a sharp, stinging "bite." "*Buenoa* while rising from time to time to the surface to renew its air supply, habitually keeps some inches below the surface, maintaining its position there by timely strokes of the posterior legs. Some of our lowland reservoirs teem with tiny crustacea, a *Daphnia*-like species for example being found in veritable clouds some distance beneath the surface. Ostracoda may also abound. Here *Buenoa* thrives.... Unlike *Arctocorixa* in Hawaii, *Buenoa* seems quite unable to endure salt water." (Williams, 1944:193–194, fig. 15.)

Family **CORIXIDAE** (Leach, 1815) Dohrn, 1859

The Water Boatmen

Elongate-oval, subdepressed, aquatic bugs; head overlapping prothorax, eyes large, subcontinuous in outline with the head, inter-ocular space wide, ocelli absent; antennae concealed from above beneath the edges of the eyes, four-segmented; rostrum short, broad, triangular, appearing as a continuation of the face, not distinctly beak-like as in most bugs; scutellum concealed by the pronotum; hemelytra complete, membrane not differentiated in texture from corium, veins wanting; fore coxae separated, mid and hind coxae contiguous or nearly so, front legs short, their tarsi composed of a single, large, expanded, fimbriated segment;

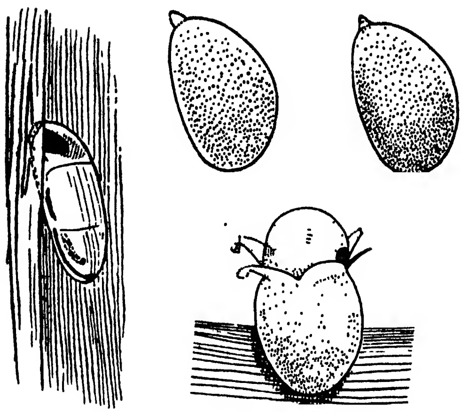


Figure 108—Eggs of two aquatic Heteroptera: left, *Buenoa pallipes* (Fabricius), egg embedded in plant tissue; right, eggs of *Trichocorixa reticulata* (Guérin-Méneville). Lower figure shows a nymph hatching from an egg. (After Williams, 1944.)

middle legs long and slender, tarsi single-segmented with two setaceous claws about as long as the tarsus; hind legs stouter, the two-segmented clawless tarsi compressed, expanded and fringed with long hairs; abdomen of males with the terminal three segments asymmetrical, twisted to the left or right.

The mouth parts of these bugs are peculiar and alone will separate them widely from all other Hemiptera. The rostrum is abbreviated and not elongated as is normal for bugs. This structure makes it possible for the bugs to swallow entire filaments of algae and to ingest certain small organisms whole.

Genus **TRICHOCORIXA** Kirkaldy, 1908

Trichocorixa reticulata (Guérin-Méneville) (figs. 108, 109).

Corisa reticulata Guérin-Méneville, in Sagra's Hist. de Cuba, 6:423, 1857.
Corixa Wallengreni Stål, 1859:268.
Corixa blackburni White, 1877:114.
Arctocorixa blackburni (White) of various authors.
See Sailer, 1946:617–620, for detailed synonymy, bibliography and notes.

Water boatman.

Oahu, Molokai, Maui.

Immigrant. A widespread American species (described from Cuba); established early in Hawaii.

This abundant insect looks, vaguely, more like some kind of a leafhopper than a bug. It frequently comes to light, sometimes in large numbers. It is common in brackish pools in the lowlands, but sometimes ventures up into the mountains. The small, whitish, top-shaped eggs are cemented to submerged objects. It is truly an

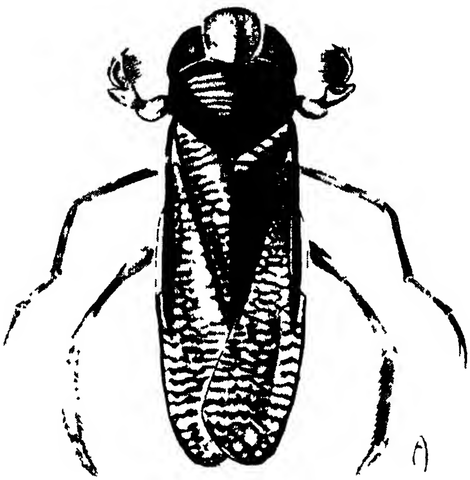


Figure 109—*Trichocorixa reticulata* (Guérin-Méneville), the water boatman. (Abernathy drawing.)

aquatic bug, and it can stay submerged for long periods of time. Its food consists of plant materials, such as filamentous algae and diatoms, and small animals which are found in the mud and ooze at the bottoms of ponds. Each pair of legs is adapted for a different purpose: the front ones are modified as scoops or shovels for food getting, the long slender middle ones are used to hold the insect in place while feeding, and the paddle-like hind legs are used for swimming.

The males stridulate by rubbing a series of small processes on the fore tarsi on a roughened area on the opposite femur. There is also an apparent stridulatory organ on the dorsum of the abdomen.

Blackburn's field notes (as recorded by White, 1878:366) are as follows: "Very common in salt-water pools on the sea-shore. These pools are formed artificially for the manufacture of salt. As the liquid becomes more dense by evaporation, the *Corixae* migrate to pools more recently filled. Some would appear, however, to remain too long, as, in the last stage of evaporation, the pools generally contain a few dead *Corixae*..."

From Williams (1944:195–196, fig. 16) the following notes are abstracted:

Our water boatman measures about 4.5 mm. long. The back of the thorax is finely banded with blackish while the elytra are finely but irregularly banded with brownish to black. The long posterior legs are hair fringed for propulsion by swift strokes.... It may fairly swarm in salty pools separated from the ocean by a low sandbar.... It is a bottom insect, coming to the surface only for air or to take flight.... Our corixid often takes flight in the daytime. It would seem that the shining surface of water attracts *Arctocorixa*, and we have seen them in the bright sunshine crashing against the polished hood of an automobile, evidently mistaking the shining metal for their proper element.

ADDENDUM

As noted on page 44, details of the identity and discovery of the following addition to our fauna were obtained while this volume was in press. Under the Alydinae, and following the section on *Ithamar* on page 47, add the following:

Coriscus pilosulus (Herrich-Schaeffer) (fig. 110).

Alydus pilosulus Herrich-Schaeffer, Abbildung Wanzenartiger Insecten 8:101, fig. 870, 1848. (I have not checked this reference.)

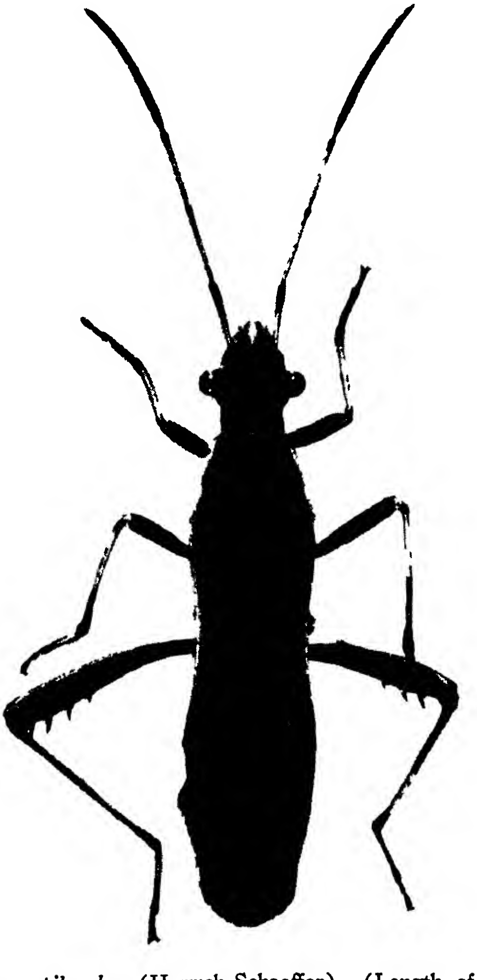


Figure 110—*Coriscus pilosulus* (Herrich-Schaeffer). (Length of body: 11 mm.)

Oahu.

Immigrant. First discovered in Hawaii by F. A. Bianchi, C. E. Pemberton and R. H. Van Zwaluwenburg at Poamoho, Oahu, May 25, 1948. Widespread in the United States from New England south to Florida and west to California.

The nymphs resemble ants, and it was this stage of the bug which first attracted the attention of Mr. Bianchi and resulted in the discovery of the insect in Hawaii. Bianchi fed specimens on *Leucaena glauca* and *Crotalaria* in the laboratory, but no feeding was observed in the field where the insect was found in a restricted area of weeds. Blatchley (1926:267) gives a redescription of the species and notes that it is common on *Saponaria* in Indiana and that it is "Frequent on weeds and grasses along the sandy margins of ponds."

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INSECTS OF HAWAII

INSECTS OF HAWAII

A Manual of the Insects of the Hawaiian Islands, including an Enumeration of the Species and Notes on their Origin, Distribution, Hosts, Parasites, etc.

by **ELWOOD C. ZIMMERMAN**
Associate Entomologist, Experiment Station, Hawaiian Sugar Planters' Association; Curator of Entomology, Bernice P. Bishop Museum

VOLUME 4

HOMOPTERA: AUCHENORHYNCHA

Sponsored by

BERNICE P. BISHOP MUSEUM • EXPERIMENT STATION, HAWAIIAN SUGAR PLANTERS' ASSOCIATION • UNIVERSITY OF HAWAII

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PREFACE TO VOLUME 4

This is the fourth volume of *Insects of Hawaii.* In it are recorded 313 species of auchenorhynchus Homoptera, most of which are referred to commonly as leafhoppers. Only 16 of these species are not native insects, and the group forms one of the major sections of the endemic Hawaiian fauna. Comparatively little is known about any except a few of the native species; a vast amount of information concerning the group is yet to be recorded and a large number of new species remains to be described. The 16 immigrant species include such well-known pests as the sugarcane leafhopper, corn leafhopper, bean leafhopper and taro leafhopper which have caused damage to Hawaiian crops amounting to millions of dollars.

Reference should be made to the "Preface to the First Five Volumes," in Volume 1 of this work, for a detailed outline of these volumes and for general acknowledgments and comment. The other volumes of this series are: 1, *Introduction;* 2, *Apterygota–Thysanoptera;* 3, *Heteroptera;* and 5, *Homoptera: Sternorhyncha.*

The drawings for this volume were made mostly by Frieda Abernathy, University of California; Arthur Smith, British Museum (Natural History); and the author. The photographs were made by W. Twigg-Smith and J. T. Yamamoto, Experiment Station, H.S.P.A., most of them by Mr. Yamamoto.

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E.C.Z.

Honolulu
August, 1948

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CHECKLIST OF THE INSECTS IN THIS VOLUME

Order **HEMIPTERA**

Suborder HOMOPTERA

Series Auchenorhyncha

Superfamily Cicadoidea

Family CERCOPIDAE

Subfamily Aphrophorinae

Genus **PHILAENUS** Stål
  spumarius (Linnaeus)

Family CICADELLIDAE

Subfamily Tettigellinae

Genus **ACOPSIS** Amyot and Serville
  minerva (Ball)
  mollipes (Say)

Subfamily Macropsinae

Genus **MACROPSIS** Lewis
  occidentalis (Van Duzee)

Subfamily Typhlocybinae

Genus **EMPOASCA** Walsh
  solana DeLong

Subfamily Jassinae

Genus **STRAGANIA** Stål
  Subgenus **Penestragania** Beamer and Lawson
    robusta (Uhler)

Subfamily EUSCELINAE

Genus **NESOPHRYNE** Kirkaldy
kaiamamao (Kirkaldy)
kukanaroa (Kirkaldy)

Genus **KIRKALDIELLA** Osborn
euphorbiae Osborn
ewana Osborn

Genus **NESOPHROSYNE** Kirkaldy
Subgenus **Nesophrosyne** Kirkaldy
affinis Osborn
albicosta Osborn
angulifera Osborn
bicolorata Osborn
bobeae Kirkaldy
caelicola Kirkaldy
cinerea Osborn
craterigena Kirkaldy
cuprescens Osborn
ehu Kirkaldy
furculata Osborn
giffardi giffardi Kirkaldy
giffardi interrupta Osborn
gouldiae Kirkaldy
haleakala Kirkaldy
halemanu Kirkaldy
ignigena Kirkaldy
imbricola Kirkaldy
lineata Osborn
mabae Osborn
maritima Kirkaldy
milu Kirkaldy
monticola Kirkaldy
montium Kirkaldy
montivaga Kirkaldy
myrsines Kirkaldy
nimbicola Kirkaldy
nimbigena Kirkaldy
notatula Osborn
nubigena Kirkaldy
nuenue Kirkaldy
obliqua Osborn
oneanea Kirkaldy

opalescens Kirkaldy
oreadis Kirkaldy
palolo Osborn
paludicola Kirkaldy
palustris Kirkaldy
pele Kirkaldy
peleae Osborn
perkinsi (Kirkaldy)
pipturi Kirkaldy
pluvialis Kirkaldy
ponapona Kirkaldy
procellaris Kirkaldy
signatula Osborn
silvicola Kirkaldy
silvigena Kirkaldy
sinuata Osborn
touchardii Osborn
ulaula ulaula Kirkaldy
ulaula nigrolineata Kirkaldy
umbratilis Kirkaldy
umbricola Kirkaldy
umbrigena Kirkaldy

Subgenus **Nesoreias** Kirkaldy
comma Osborn
eburneola Osborn
insularis Kirkaldy
koleae (Kirkaldy)
marginalis Osborn
oceanides Kirkaldy
sanguinea Osborn

Genus **DELTOCEPHALUS** Burmeister
hospes Kirkaldy

Genus **OPSIUS** Fieber
stactogalus (Amyot)

Genus **BALCLUTHA** Kirkaldy
hospes (Kirkaldy)
kilaueae (Kirkaldy)
peregrina (Kirkaldy)
plutonis (Kirkaldy)
timberlakei (Osborn)
volcanicola (Kirkaldy)

Genus **NESOLINA** Osborn
lineata Osborn

Family MEMBRACIDAE

Subfamily Smiliinae

Tribe ceresini

Genus **STICTOCEPHALA** Stål
festina (Say)

Subfamily Centrotinae

Genus **TRICENTRUS** Stål
albomaculatus Distant

Superfamily Fulgoroidea

Family CIXIIDAE

Subfamily Cixiinae

Tribe cixiini

Genus **OLIARUS** Stål
acaciae Kirkaldy
albatus Giffard
consimilis Giffard
discrepans Giffard
euphorbiae Giffard
filicicola Kirkaldy
haleakalae Kirkaldy
halehaku Giffard
halemanu Giffard
hevaheva Kirkaldy
immaculatus Giffard
inaequalis inaequalis Giffard
inaequalis koebelei Metcalf
inaequalis kohala Metcalf
inaequalis konana Metcalf
inconstans Giffard
instabilis instabilis Giffard

instabilis bryani Metcalf
instabilis crawi Metcalf
instabilis ehrhorni Metcalf
instabilis osborni Metcalf
instabilis terryi Metcalf
instabilis williamsi Metcalf
intermedius Giffard
kahavalu Kirkaldy
kaiulani Giffard
kanakanus kanakanus Kirkaldy
kanakanus punaensis Metcalf
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kaohinani perkinsi Metcalf
kaonohi Kirkaldy
kauaiensis Kirkaldy
kaumuahona Giffard
kirkaldyi Giffard
koae Giffard
koanoa Kirkaldy
koele Giffard
kulanus Giffard
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likelike Giffard
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mauiensis Giffard
montanus Giffard
monticola Kirkaldy
morai (Kirkaldy)
muiri Giffard
myoporicola Giffard
neomorai neomorai Giffard
neomorai oahuana Metcalf
nemoricola Kirkaldy
neotarai Giffard
niger Giffard
nubigenus Kirkaldy
olympus olympus Giffard
olympus paliensis Metcalf
opuna Kirkaldy
orono orono Kirkaldy
orono molokaiensis Kirkaldy
orono oahuensis Kirkaldy
paludicola Kirkaldy
pele pele Kirkaldy

pele alpha Metcalf
pele beta Metcalf
pluvialis Kirkaldy
procellaris Kirkaldy
silvestris Kirkaldy
similis similis Giffard
similis lanaiana Metcalf
similis mauiana Metcalf
similis molokaiana Metcalf
swezeyi Giffard
tamehameha Kirkaldy
tantalus Giffard
tarai tarai Kirkaldy
tarai hawaiiensis Metcalf
tarai kohalana Metcalf
waialeale Giffard
wailupensis Giffard

Genus **IOLANIA** Kirkaldy
koolauensis Giffard
lanaiensis Giffard
mauiensis Giffard
oahuensis Giffard
perkinsi perkinsi Kirkaldy
perkinsi notata Kirkaldy

Family DELPHACIDAE

Subfamily DELPHACINAE

Tribe ALOHINI

Genus **LEIALOHA** (Kirkaldy)
hawaiiensis (Muir)
kauaiensis (Muir)
lanaiensis (Muir)
lehuae (Kirkaldy)
mauiensis (Muir)
naniicola (Kirkaldy)
oahuensis (Muir)
oceanides (Kirkaldy)
ohiae (Kirkaldy)
pacifica (Kirkaldy)
scaevolae Muir
suttoniae Muir

Genus **NESOTHOË** Kirkaldy
antidesmae (Muir)
bobeae Kirkaldy
dodonaeae (Muir)
dryope (Kirkaldy)
elaeocarpi (Kirkaldy)
eugeniae (Kirkaldy)
fletus Kirkaldy
frigidula Kirkaldy
giffardi (Kirkaldy)
gulicki (Muir)
haa (Muir)
hula Kirkaldy
laka Kirkaldy
maculata (Muir)
munroi (Muir)
perkinsi Kirkaldy
piilani Kirkaldy
pluvialis Kirkaldy
semialba (Muir)
seminigrofrons (Muir)
silvestris Kirkaldy
terryi Kirkaldy

Genus **NESODRYAS** Kirkaldy
freycinetiae Kirkaldy
swezeyi Zimmerman

Genus **ALOHA** Kirkaldy
artemisiae (Kirkaldy)
campylothecae Muir
dubautiae (Kirkaldy)
flavocollaris Muir
ipomoeae Kirkaldy
kirkaldyi Muir
myoporicola Kirkaldy
plectranthi Muir
swezeyi Muir

Genus **NESORESTIAS** Kirkaldy
filicicola Kirkaldy
nimbata (Kirkaldy)

Genus **NOTHORESTIAS** Muir
badia Muir
swezeyi Muir

Genus **DICTYOPHORODELPHAX** Swezey

- **mirabilis** Swezey
- **praedicta** Bridwell
- **swezeyi** Bridwell
- **usingeri** Swezey

Genus **NESOSYDNE** Kirkaldy

- **acuta** (Muir)
- **ahinahina** (Muir)
- **aku** (Muir)
- **amaumau** (Muir)
- **anceps** Muir
- **argyroxiphii** Kirkaldy
- **asteliae** Muir
- **boehmeria** (Muir)
- **bridwelli** (Muir)
- **campylothecae** (Muir)
- **chambersi** Kirkaldy
- **coprosmicola** (Muir)
- **cyathodis** Kirkaldy
- **cyrtandrae** Muir
- **cyrtandricola** Muir
- **dubautiae** (Muir)
- **eeke** (Muir)
- **fullawayi** (Muir)
- **geranii** (Muir)
- **giffardi** Muir
- **gigantea** (Muir)
- **gouldiae** Kirkaldy
- **gunnerae** Muir
- **haleakala** Kirkaldy
- **halia** Kirkaldy
- **hamadryas** Kirkaldy
- **hamata** Muir
- **imbricola** Kirkaldy
- **incommoda** Muir
- **ipomoeicola** Kirkaldy
- **koae** Kirkaldy
- **koae-phyllodii** Muir
- **koebelei** Muir
- **kokolau** (Muir)
- **kuschei** (Muir)
- **lanaiensis** (Muir)
- **leahi** (Kirkaldy)

lobeliae Muir
longipes (Muir)
mamake (Muir)
mauiensis (Muir)
monticola Kirkaldy
montis-tantalus Muir
naenae (Muir)
neocyrtandrae (Muir)
neoraillardiae (Muir)
neowailupensis (Muir)
nephelias Kirkaldy
nephrolepidis Kirkaldy
nesogunnerae Muir
nesopele (Muir)
nigriceps Muir
nigrinervis (Muir)
nubigena Kirkaldy
oahuensis Muir
olympica (Muir)
osborni Muir
painiu (Muir)
palustris Kirkaldy
perkinsi Muir
phyllostegiae Muir
pilo (Muir)
pipturi Kirkaldy
procellaris Kirkaldy
pseudorubescens Muir
raillardiae Kirkaldy
raillardiicola (Muir)
rocki Muir
rubescens (Kirkaldy)
rubescens pele (Kirkaldy)
sharpi Muir
sola Muir
stenogynicola (Muir)
sulcata (Muir)
swezeyi Muir
tetramolopii (Muir)
timberlakei Muir
ulehihi (Muir)
umbratica Kirkaldy
viridis (Muir)
waikamoiensis (Muir)
wailupensis (Muir)

Tribe DELPHACINI

Genus **PERKINSIELLA** Kirkaldy
saccharicida Kirkaldy

Genus **PEREGRINUS** Kirkaldy
maidis (Ashmead)

Genus **LIBURNIA** Stål
paludum (Kirkaldy)

Genus **KELISIA** Fieber
emoloa Muir
eragrosticola Muir
sporobolicola sporobolicola Kirkaldy
sporobolicola immaculata Muir
swezeyi Kirkaldy

Genus **TAROPHAGUS** Zimmerman
proserpina (Kirkaldy)

Genus **MEGAMELUS** Fieber
angulatus Osborn

Family FLATIDAE

Subfamily FLATINAE

Genus **SIPHANTA** Stål
acuta (Walker)

Order **HEMIPTERA**, continued

Suborder **HOMOPTERA** (Leach, 1815) Latreille, 1817

Omoptera Leach, 1815.

Leafhoppers, Treehoppers, Spittlebugs, Psyllids, White Flies, Aphids, Mealybugs, Scales

This suborder is distinguished from the Heteroptera chiefly as follows: wings usually held roof-like over the abdomen, fore pair without two fields, of nearly uniform texture throughout, although frequently more rigid than the hind pair, usually membranous; rostrum appearing to arise between the fore coxae; gular region indistinct; wingless forms common.

Minute to large insects of many forms; body soft to heavily sclerotized; active or sedentary, many saltatorial. Head hypognathous, ventral part abutting fore coxae in many groups; cephalic sutures variably modified, often obscure; compound eyes present or absent; ocelli two or three or none; antennae variable, moniliform, filiform or styliform, reduced to three or four or fewer segments in some groups and obsolete in others, with a maximum of 25 segments in some male coccids, usually with variformed sensoria; mouth parts, as in the Heteroptera, highly modified for piercing plant tissue and sucking fluids, produced into a variable beak which usually projects caudad between the legs; clypeus, labrum and epipharynx variable, often fused and/or variously modified; stylets usually very long, retractile and coiled within the body in some forms. Thorax variable, distinctly divided in winged forms, not greatly differentiated from abdomen in some apterous forms. Legs ambulatory or saltatory, reduced or absent in many female scales; tarsi one- to three-segmented, absent in some forms, with one or two claws, or none. Wings present or absent and variously modified, the hind pair reduced to halteres in male coccids, apterous forms common, brachypterous and long-winged forms frequently occurring in same species; venation usually greatly reduced. Abdomen usually much modified, basically 11-segmented, but frequently much reduced, cerci absent; ovipositor well developed to absent. Metamorphosis gradual; eggs laid free, inserted in plant tissue, deposited in waxy ovisacs formed by the female, or developed ovoviviparously; parthenogenetic forms common, predominant in some groups. Some families containing species with highly developed wax-forming glands, many forms great honeydew producers; a highly variable group of herbivores, many active, many saltatorial, many immobile in adult female state.

It is impossible to write an adequate description of the Homoptera without going into great detail because the group consists of so many variable and complex groups. The notes above are only a bare outline. Because of this diversity, the suborder as a whole has a less well-coordinated literature than does the Heteroptera. In fact, many of the families have attracted specialists who have limited themselves, by necessity, to single groups as other workers have attached themselves to entire orders.

Homoptera have been traced back in the fossil record to the Triassic. Today the suborder is well represented over all of the world.

Although Hawaii has a magnificently developed endemic homopterous fauna, insofar as species go, none of the native forms was described until 1902 when Kirkaldy wrote his first paper for *Fauna Hawaiiensis*. Certain immigrant species, especially coccids, were listed by name from the islands some years previously, however. After Kirkaldy's first report, our knowledge of the native Homoptera grew rapidly. The establishment of the sugarcane leafhopper gave impetus to the study of local forms and resulted in the transfer of the specialists Kirkaldy and Muir from England to Hawaii. The bulk of our native Homoptera was described by these two workers, but Crawford entered the field to expand our knowledge of the Psyllidae, Giffard revised the Cixiidae, and Osborn revised the Cicadellidae. Since Kirkaldy and Muir left the scene, the native Homoptera have received little attention by writers. The interest and activities pertaining to the economic forms have continued and have been increasing in the last few years. However, before these volumes no attempt had been made to gather data pertinent to the entire suborder in one place.

Although we have a specifically well-developed endemic homopterous fauna, it is an "unbalanced" one, as compared to continental faunas. I refer to it as "unbalanced" because, of the series known elsewhere, only a few groups are represented. The only families represented by endemic species are the Cicadellidae, Cixiidae, Delphacidae, Psyllidae and the Pseudococcidae. The characteristic groups of the continents—Cicadidae, Cercopidae, Membracidae, Flatidae, Issidae, Ricaniidae, Fulgoridae, Aphididae, the many families of Coccoidea—are wanting from the native fauna. The few families which are surely represented by native species are further limited. The native Cicadellidae are represented by only five or six genera. Two genera represent the Cixiidae. Seven genera represent the Delphacidae, and six of these are closely interrelated endemics. The endemic Pseudococcidae are contained in six genera.

One unusual feature of the endemic homopterous fauna is the almost entire lack of grass- and sedge-feeding species which are so dominant in continental areas. With the exception of the few species of *Kelisia* (Delphacidae) and *Balclutha* (*Nesosteles*) (Cicadellidae), all of our many positively native Homoptera feed upon trees (mostly), shrubs, herbs, vines or ferns. The locally abnormal habit of the grass-feeding *Kelisia* and *Balclutha* has been a factor in leading some workers to consider them as non-endemic, but the data now assembled are adequate

to establish their endemicity beyond a doubt. *Nesolina* will have to be added to this group if it proves to be endemic.

The suborder Homoptera contains many of the most serious of agricultural pests. Our two best-known species are the sugarcane leafhopper and the pineapple mealybug, each of which has caused damage that can only be estimated in millions of dollars. The many scales and aphids now established in the islands confront all agriculturists with a constant and ever-growing series of control problems. There are no homopterous insects in these islands which can be called obviously beneficial to man, although the native forms are mostly "neutral." Many species carry various kinds of plant diseases, and some forms become so abundant on their hostplants as literally to suck the life out of them. They are mostly prolific, fast-growing creatures—some incredibly so. Some have yielded to biological control, but others have withstood all attempts to control them satisfactorily by natural means.

TABULAR ANALYSIS OF THE HAWAIIAN HOMOPTERA

FAMILY	GENERA	ENDEMIC GENERA	NON-ENDEMIC GENERA	SPECIES	ENDEMIC SPECIES	ADVENTIVE SPECIES
Cercopidae	1	0	1	1	0	1
Cicadellidae	12	4	8	80	73	7
Membracidae	2	0	2	2	0	2
Cixiidae	2	1	1	84	84	0
Delphacidae	14	8	6	145	140	5
Flatidae	1	0	1	1	0	1
Psyllidae	8	5	3	31	31	0
Aleyrodidae	5	0	5	7	0	7
Aphididae	24	0	24	47	0	47
Margarodidae	1	0	1	1	0	1
Ortheziidae	1	0	1	1	0	1
Pseudococcidae	12	3	9	35	14	21
Asterolecaniidae	1	0	1	4	0	4
Kermidae	1	0	1	2	0	2
Coccidae	5	0	5	15	0	15
Diaspididae	25	0	25	49	0	49
Totals	115	21	94	505	342	163

Percentage of endemism in native group: genera, 88 percent; species, 100 percent.
Percentage of present-day fauna native: 68 percent.
Percentage of present-day fauna adventive: 32 percent
Average number of species per genus in native group: 12
Average number of species per genus in adventive group: 2.

Key to the Series of Homoptera

(Adults)

1. Tarsi three-segmented; antennae short, with a terminal arista .... **Auchenorhyncha.**
2. Tarsi one- or two-segmented; antennae without a terminal arista; often immobile forms (scales, etc.) .... **Sternorhyncha.**

Series AUCHENORHYNCHA Duméril, 1806

This division includes the larger, less-specialized Homoptera. The wing venation is not reduced as it is in the Sternorhyncha.

Key to the Superfamilies

1. Mesocoxae not elongate, their points of articulation subcontiguous and distant from wings; tegulae absent...... **Cicadoidea.**
2. Mesocoxae conspicuously elongate, often twice as long as broad, their points of articulation much farther apart than greatest chord of a coxa, toward sides of body and often near wings; tegulae present.............................. **Fulgoroidea.**

Superfamily CICADOIDEA Ashmead, 1904

Key to the Families Found in Hawaii

1. Pronotum unusually large, produced backward as a sharp process over abdomen and nearly or entirely hiding scutellum...... .... **Membracidae.**
   Pronotum not so formed, scutellum visible.................. 2
2. At least hind tibiae conspicuously multispinose or serially spinose; hind coxae strongly expanded laterad, reaching to sides of sterna or to edges of wings.............. **Cicadellidae.**
   Tibiae with at most two stout spur-like spines on outer edge (in addition to terminal spines) and never multispinose in our species; hind coxae subconical and not expanded to sides of sterna................................ **Cercopidae.**

The nymphs may be separated as follows:

1. Dorsum granulate............................ **Membracidae.**
   Dorsum not granulate.................................... 2
2. Tibiae multispinose; nymphs free and active......... **Cicadellidae.**
   Tibiae not multispinose along their lengths; nymphs normally hidden by surrounding masses of froth............ **Cercopidae.**

NOTES ON KIRKALDY'S TYPES OF HAWAIIAN LEAFHOPPERS

(Cicadellidae and Delphacidae)

The natural difficulties encountered in attempting a study of the extensively speciated Hawaiian leafhoppers are intensified by confusion caused largely by carelessness on the part of certain of the authors of the known species. Fortunately, some private notes written by Dr. Perkins have served to clarify some

muddled situations. Dr. Swezey has kindly made available to me a letter written by Perkins to Muir on January 31, 1922, which contains this invaluable information. It is of such importance that I believe that most of it should be printed here and thus preserved for future workers. The letter is in the files of the Hawaiian Sugar Planters' Association Experiment Station. It is divided into two principal parts, the first a narrative, the second a list of species with notes on their types and other remarks. Nearly all of the narrative is printed below, but the notes are segregated and are placed under the species headings farther along in the text, and I have added some comments where additional information has been available.

I am sending herewith ... a box containing a number of Hawaiian leafhoppers, containing a considerable number of actual types of Kirkaldy's, and others which were certainly cotypes and some which I compared with his actual types, but which he did not see....

The specimens look more untidy than mine usually do. I did not care in this case to remount any, nor to remove the very untidy MS. labels of K's, as I think they ought to be left on, until some one better informed than myself on the species has examined them. The flaring red labels I am quite sure must indicate the specimen or specimens that would have been labelled as the actual types. In some cases there are specimens without this peculiar label, which were actual types, I believe.

When the final proofs of the Suppl. to Hemiptera [in *Fauna Hawaiiensis*] came to Honolulu after K's death, I went through all the specimens I could find. It is very likely I missed some, since so far as I remember, they were scattered here and there in a score or more of boxes mixed up more or less with things not Hawaiian. Kershaw helped me a good deal with Kirkaldy's boxes.

I kept one of the duplicate copies of the proofs of F. H. [*Fauna Hawaiiensis*] and wrote on these a lot of remarks about both the Homops. and Heterop. In a number of cases the MS. name on an evident type did not occur in the proofs at all, the name having evidently been changed for what he considered a better one by K.—or for some other reason. In such cases it was easy to fix which printed name belonged to the (different) MS. name, by considering the date and locality and the description. These together furnished positive evidence of the valid name of the doubly-named specimens.

I think I failed to find any representative of some described species at all, probably because these had been eaten up, as a vast number of specimens were, during K's illnesses. You will easily see signs of "frass" of *Psocus* etc. on some of the cards now, though I cleaned off the worst of this. I have no specimens, that I have had sole charge of, that show any signs of this, though some of Blackburn's are bad and he let many of his Neuroptera be almost entirely destroyed.

The notes which I made on K's species at the time indicate chiefly the destination of the type, but in some cases there are other remarks. I may have sent these notes out before, but in any case I have copied them again. Type S.I.C. = belonging to Sandwich Is. Committee and no doubt these are all in the Brit. Mus. now. K. agreed to make types of S.I.C. specimens before all others, as he had undertaken those first....

I think I told you I collected leafhoppers most particularly on Molokai and Lanai, much more than elsewhere, as also the land shells of those Islands. Unfortunately these were nearly all destroyed and there were hundreds of cards of these and also of smaller Heterops. (chiefly Capsidae) entirely cleared of their contents or with only remnants left. K. must have described only a fraction of what I got. I particularly remember the great numbers of Delphacids on Molokai, when I was beating for Coleops. etc., but Jassids were more numerous in individuals on Hawaii. One year they were dead of some fungus disease in countless thousands in the Kona district and in a few minutes I remember filling several pill boxes, as they stuck, dead,

but lifelike, on the trees. No doubt these were mostly one species. I never saw another epidemic like this, and if the fungus attacked the species indiscriminately, it would go hard with the rarer ones on such an occasion!...

There are signs of verdigris on some of the beasts I pinned with silver wires, as happens when they put in too much alloy. I think it was only specimens that were pinned from Molokai that escaped being eaten up, all the carded ones were cleared off, so pinning has some advantages in this case and I wish I had pinned more.

It is quite possible that I may have overlooked some species, not specially labelled, in the (named) collection I possess, as I have not examined the specimens critically on this occasion, but I took a very great deal of trouble over them at the time I corrected K's last proofs. Casually examined, they appear to me correct....

Family CERCOPIDAE (Leach, 1815)

Spittlebugs, Froghoppers

This group is not represented in the native Hawaiian fauna, and it was only recently (1944) that a foreign species was reported to have become established here.

The name "spittlebug" is derived from the frothy material produced by the nymphs and in which they live on their hostplants. These peculiar masses of "cuckoo-spit" are characteristic of the family and are usually conspicuous in the areas in which the insects occur. The frothy substance is considered to protect the pale, delicate nymphs from drying and, at least to a considerable degree, from their enemies. Cecil (1930:125) describes the formation of the froth in *Philaenus leucophthalmus* Linnaeus as follows:

> The nymph increases in size as it feeds, and after feeding from 1 to 2 minutes it excretes a clear fluid from the anus. In from 5 to 12 minutes the nymph is completely covered with the fluid. The position of the tip of the abdomen when the fluid is excreted, causes the fluid to flood the dorsal surface of the abdomen and run off the sides of the body. When the nymph is covered with clear fluid the tip of the abdomen is extended outside the fluid. While outside the fluid, the posterior lateral folds are opened to allow entry of air, then closed as the abdomen is retracted into the fluid. The body of the nymph is then contracted and a bubble of air is released into the fluid. This process is performed repeatedly until the clear fluid becomes a white frothy mass or spittle. In the method of forming the spittle I agree with Morse [A Bubble-blowing Insect, *Popular Science Monthly*, 57:23–29, figs. 1–6, 1900] but do not agree with him that the anal appendages serve as gills when the nymph is covered with spittle.

The family characters of the single species established in Hawaii may be summarized briefly as follows: head with two ocelli; antennae appearing to have an enlarged, two-segmented basal part upon which is articulated a long, fine seta which arises from a bulbous base which simulates a third segment to the basal segments; hind coxae subconical and at all parts distant from the lateral edges of the pleura; tibiae subcylindrical, posterior pair with two stout spines on the outer side and a cluster of spines at the apex.

The cercopids are thought to be most closely allied to the Cicadidae, a group which is not represented in Hawaii. In our fauna, they most closely resemble the Cicadellidae, from which family they are most easily distinguished by their comparatively simple hind tibiae which lack rows of numerous, conspicuous spines.

The family is fairly well represented elsewhere in Oceania, especially by the genus *Lallemandana.*

Subfamily APHROPHORINAE (Amyot and Serville, 1843)

Genus PHILAENUS Stål, 1864

Philaenus spumarius (Linnaeus) (fig. 1).
Cicada spumaria Linnaeus, 1758:437.

Figure 1—*Philaenus spumarius* (Linnaeus). The meadow froghopper, a spittlebug.

The meadow froghopper.

Hawaii.

Immigrant. A widespread species in Europe and North America. First found in the Territory at Kilauea, Hawaii, by W. C. Goolsby in 1944 and reported by Richard Faxon, *Proc. Hawaiian Ent. Soc.* 12(2):219, 1945, as *P. leucophthalmus* (Linnaeus).

Hostplants: *Anagallis arvensis, Artemisia vulgaris, Bidens pilosa minor, Brassica oleracea botrytis,* celery, *Centaurium umbellatum, Chrysanthemum maximum, Coix lacryma-jobi, Commelina diffusa, Coprosma ernodioides typica, Coprosma rhynchocarpa, Cordyline terminalis, Cynodon dactylon, Cyperus brevifolius, Dactylis glomerata, Dahlia, Daucus carota sativa, Dianthus chinensis, Digitaria pruriens, Erigeron albidus, Fuchsia magellanica, Geranium carolinianum australe, Gnaphalium purpureum, Hebe salicifolia, Hibiscus tiliaceus, Holcus lanatus, Hypericum moserianum, Hypochaeris radicata, Ilex anomala, Ipomoea batatas, Lactuca sativa, Lythrum maritimum, Medicago hispida, Mentha, Mesembryanthemum, Metrosideros collina polymorpha, Modiola caroliniana, Myosotis azorica, Oenothera striata, Panicum purpurascens,* parsley, *Pastinaca sativa, Physalis peruviana, Plantago lanceolata, Pluchea odorata, Raillardia scabra, Raphanus sativus longipinnatus* (daikon radish), *Rheum rhaponticum, Rubus penetrans, Rumex acetosella, Sacciolepis contracta,* satsuma orange, *Senecio mikanioides, Solidago altissima, Sonchus oleraceus, Stachytarpheta,* strawberry, *Tibouchina semidecandra, Trifolium procumbens, Tritonia crocosmaeflora, Verbena litoralis, Veronica plebia, Vinca, Wikstroemia phillyreaefolia.*

This comparatively stout species is a brownish insect about 6 mm. long. The dorsum is densely and conspicuously clothed with short golden pubescence, and the hind margin of the pronotum is conspicuously concave at the middle. It is reported to damage various meadow plants in the United States (see Osborn and Knull 1939:101). The nymphs are soft, pale-greenish creatures.

Family CICADELLIDAE (Latreille, 1802) Latreille, 1850

Tettigonidae (Spinola, 1850) Uhler, 1876.
Jassidae (Stål, 1858) Fieber, 1866.

Cicadellids, Jassids, Leafhoppers, Sharpshooters

This family is one of the largest of the order. It is well represented in Hawaii by a large number of endemic species as well as by several immigrant forms.

The common names leafhopper and sharpshooter are derived from the active and agile way the bugs jump when disturbed.

The group is an economically important one, because certain of its species cause much damage to crop plants, not only by sucking their juices but by serving as vectors of certain plant diseases. The individuals of some species become excessively abundant and swarm on their hostplants. Fortunately, we have few species of economic importance in Hawaii, but we are in constant danger of having serious pest species break through our quarantine barriers.

Two ocelli normally are present; the antennae consist of two enlarged basal segments and a long, setaceous flagellum which is microscopically and usually indistinctly multisegmented; sides of the face explanate and extending at least over part of the fore coxae; hind coxae greatly expanded, their sides reaching to the sides of the pleura or to the edges of the wings; at least the hind tibiae with rows of numerous, conspicuous spurs and spines.

The literature containing descriptions of the native Hawaiian cicadellids is largely confined to three papers, two by Kirkaldy (1902:114–116; 1910:555–576) and one by Osborn (1935:1–62). Osborn's paper is illustrated, contains some keys and summarizes all of the group occurring in the islands. The family is a taxonomically difficult one and has been largely neglected by local entomologists. It is in considerable need of additional study, and the supra-generic nomenclature has not been stabilized. Evans' revised classification (1946–1947) was received after the manuscript for this section was written, but I have made some major changes while "in press" to follow him more closely.

Key to the Subfamilies of Cicadellidae Found in Hawaii

1. Ocelli on crown (head long and triangular in our species) .... **Tettigellinae.**
   Ocelli not on crown 2

2(1). Fore margin of pronotum in our species produced forward at middle to beyond a line drawn between apices of eyes as seen from above; lora narrow and tumescent; genae reduced to narrow strips .... **Macropsinae.**

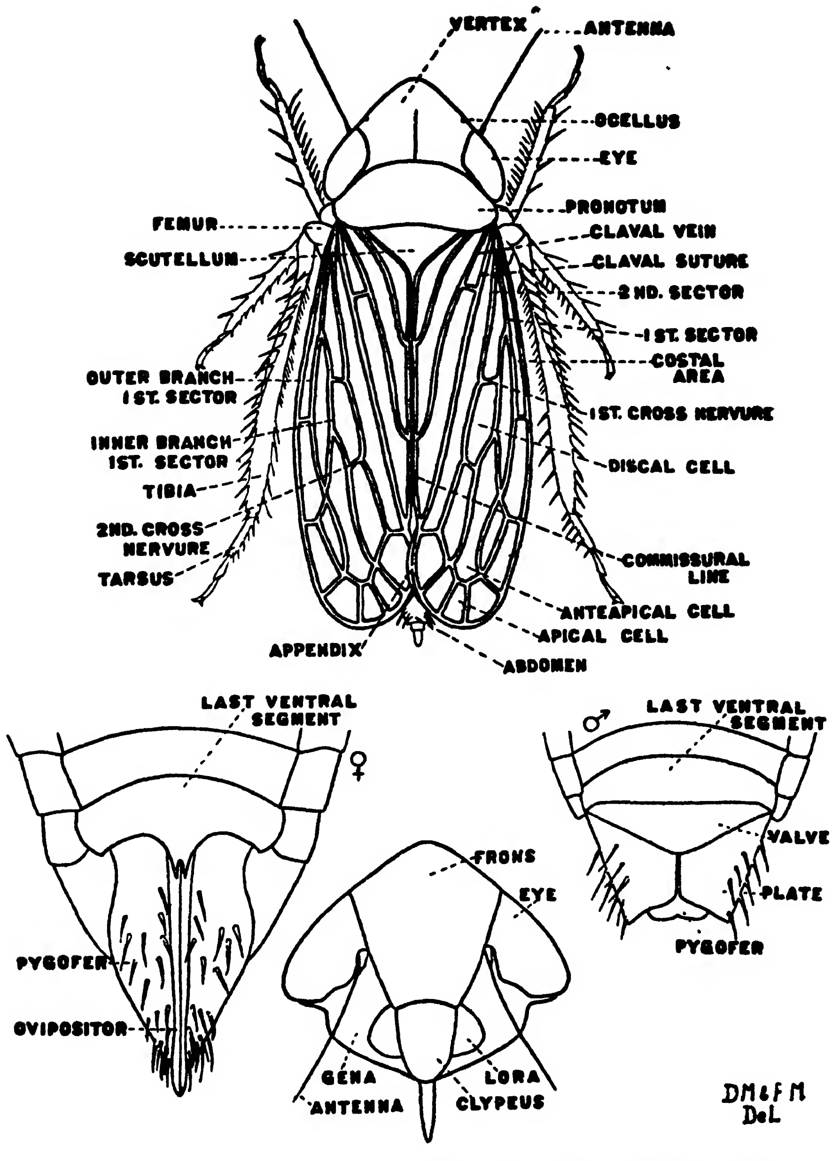

Figure 2—Features of a cicadellid leafhopper (After DeLong, 1923.)

Fore margin of pronotum not so produced, middle of fore margin behind a line drawn between fore margins of eyes: lora broad and flat; genae large and expanded........... 3

3(2). Antennae comparatively deeply inserted in a concavity which is margined on its dorsal edge by an "antennal ledge" which runs from eye onto frons; frontal sutures (from ocelli downward) obsolete; pronotum distinctly broader than head across eyes and tegminal membrane set with conspicuous spines in our species............**Jassinae.**

Antennal ledges vestigial or obsolete; frontal sutures distinct from ocelli downward; otherwise not as above....... 4

4(3). Tegminal venation reduced, appendix absent, veins forking near base and without cross-veins before apex of clavus (our species a small, slender, delicate, pale-green form) ....**Typhlocybinae.**

Tegminal venation either complete or partially reduced (*Balclutha* and *Nesolina*), but with an appendix on inner side of membrane, veins forking on disc and usually (but not always) with cross-veins before apex of clavus, thus forming discal cells.........................**Euscelinae.**

Subfamily TETTIGELLINAE

This group, which is not represented here by any native species, may be distinguished from the other Cicadellidae found in Hawaii by the positions of the ocelli. These organs are situated on the disc of the vertex (see the illustrations). The heads of our immigrant representatives, as viewed from above, are conspicuously triangular.

Genus **ACOPSIS** Amyot and Serville, 1843

Draeculacephala Ball, 1901.

These insects are referred to as "sharpshooters" because of their leaping ability. The nymphs do not have the abdominal tergites armed with long setae. These are our largest cicadellids; they attain a maximum length of 9 mm. or more. They are among the few of our species which retain their green color after preservation, and are among the commonest and most easily recognized of the group in Hawaii. The conspicuously triangular head is distinct (see the illustrations). The top of the head, the anterior and lateral borders of the pronotum, and the scutellum are greenish-yellow, and the remainder of the dorsum is grass-green. They frequently come to light in large numbers and are most abundant in areas where there is lush vegetation.

I follow Evans in the use of *Acopsis.*

Key to the Species of Acopsis Found in Hawaii

1. Median length of vertex of head of female, as measured from above, distinctly longer than median line of pronotum; male mostly pale beneath (dried specimens).........**mollipes** (Say).
2. Median length of vertex of female subequal to length of pronotum; male mostly dark beneath (dried specimens).........
....**minerva** (Ball).

Acopsis minerva (Ball) (fig. 3).

Draeculacephala minerva Ball, 1927:36.

Draeculacephala mollipes, in Hawaiian literature as the result of misidentification.

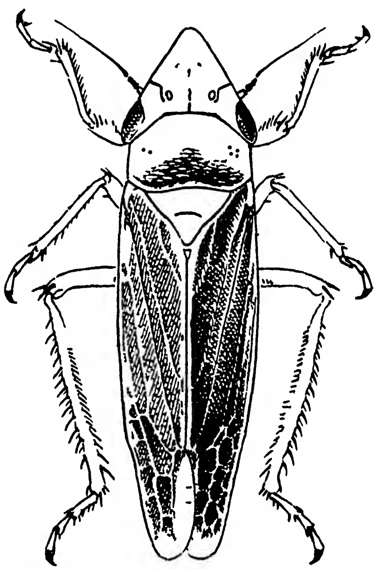

Figure 3—*Acopsis minerva* (Ball). (Abernathy drawing.)

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. A North American species. First found in Hawaii in Honolulu in 1912 by J. Nunes.

Hostplants: Bermuda grass, grasses, rice, sedges, sugarcane.

Parasites: *Gonatocerus mexicanus* Perkins (Hymenoptera: Mymaridae); *Oligosita caerulocephala* (Fullaway) and *Brachystella lutea* (Fullaway) (Hymenoptera: Trichogrammatidae); *Ootetrastichus beatus* Perkins (Hymenoptera: Eulophidae). These are all egg parasites.

Van Duzee identified the first examples of this species taken in Hawaii as *A. mollipes* (Say), but in 1942 Oman identified the species as *A. minerva.* See Swezey, O. H., *Proc. Hawaiian Ent. Soc.,* 11(3):263–264, 1943.

The eggs are long and curved. When laid in sugarcane, the tissues around the oviposition sites turn red and make conspicuous colored spots on the cane leaves.

Acopsis mollipes (Say) (fig. 4).

Tettigonia mollipes Say, 1831:312.

Draeculacephala mollipes (Say), of authors.

Kauai, Oahu, Hawaii.

Immigrant. A native of the United States. This form is a more recent arrival in the Territory than *minerva.* The earliest captures I have seen are as follows: Oahu, Honouliuli Beach, sand dunes, June 9, 1934 (E. Y. Hosaka); Hawaii, Hilo Sugar Planters' Substation, December, 1936 (F. X. Williams); Kauai, Lihue, January 28, 1939 (C. E. Pemberton).

Hostplants: watercress, and other plants not yet recorded as hosts in Hawaii.

In 1945 this species was reported to be causing serious damage to watercress near Honolulu where it swarmed on the plant. Growers reported the loss of several crops, but control was obtained by the use of rotenone.

Osborn and Knull (1939:111–114, fig. 42) give a detailed account of this species in North America. There it is called the "tenderfoot leafhopper" or the "sharp headed leafhopper."

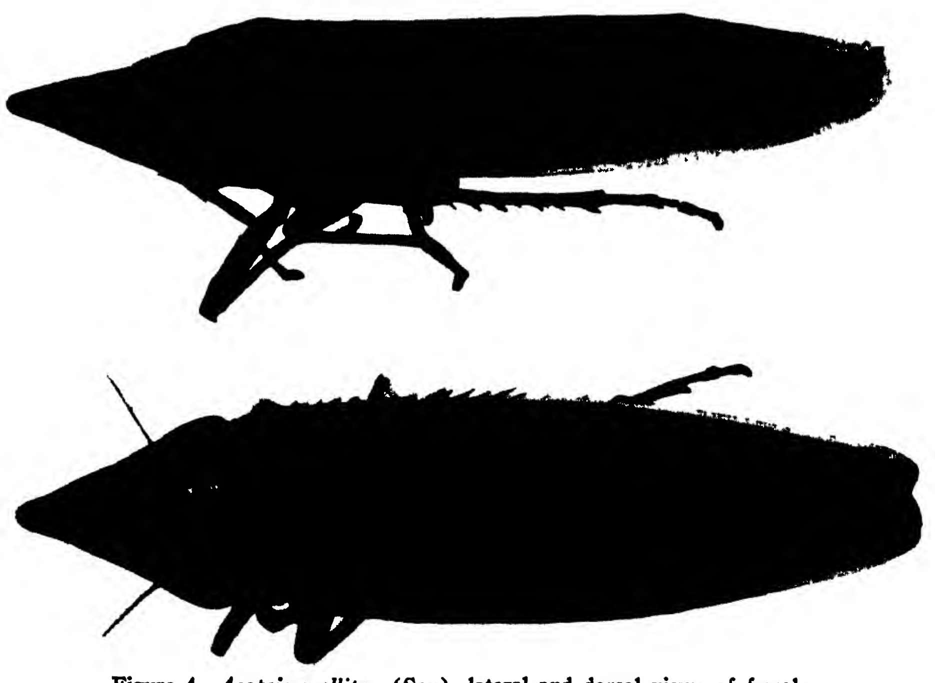

Figure 4—*Acopsis mollipes* (Say), lateral and dorsal views of female.

Subfamily MACROPSINAE Evans, 1938

Genus MACROPSIS Lewis, 1835

This genus may be distinguished most easily in Hawaii because the middle point of the anterior margin of the pronotum projects forward beyond a line drawn between the anterior edges of the eyes as indicated in the figure. It is a nearly cosmopolitan group. It is doubtfully represented in our fauna by a possibly immigrant species.

Macropsis occidentalis (Van Duzee) (fig 5)

Pediopsis occidentalis Van Duzee, 1889 238

Macropsis hawaiiensis Osborn, 1935 11, fig 1 New synonym.

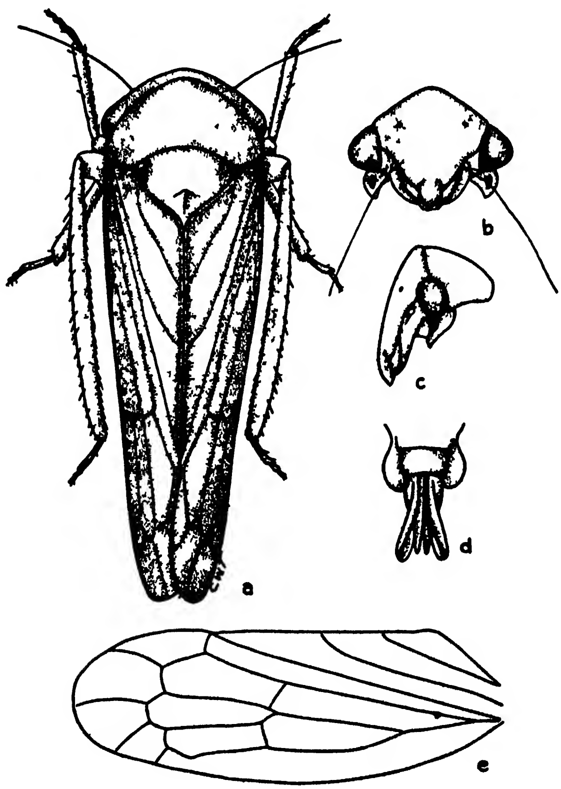

Figure 5—*Macropsis occidentalis* (Van Duzee) (from the holotype male of *hawaiiensis* Osborn). (After Osborn, 1935)

Hawaii (?).

Immigrant (?). A species from southwestern United States. This species was redescribed as a Hawaiian species by Osborn from a single male specimen supposedly taken by Giffard at 29 miles, Kilauea, 4,000 feet, on *Coprosma pubens* (?), and to my knowledge it has not been recovered in Hawaii since Giffard supposedly collected the type in 1917. Osborn noted the close relationship of his type with certain species, especially North American, and he said (1935:12), "Were it not for the very definite record given with this specimen, I should think best to omit description [of it] as it would seem possibly a straggler or accidental immigrant." The "definite record" does not remove it from the realm of an accidental immigrant. Dr. Paul Oman has kindly sent me material of *M. occidentalis* which I have compared with Osborn's type at the Bishop Museum, and the above synonymy is the result. It is doubtful that Osborn's type was collected in Hawaii. Giffard collected extensively in California and it is probable that the specimen in question is mislabeled; perhaps it got mixed with some Kilauea material by accident.

Subfamily TYPHLOCYBINAE

Eupteryginae.

We have only a single immigrant species to represent this group in our Territory. The absence of tegminal cross-veins in the basal half or more of the wing and the subbasal forking instead of discal forking of the veins serve to distinguish it from the other subfamilies found in Hawaii.

Genus **EMPOASCA** Walsh, 1862

This large, widespread genus contains a number of species of economic importance. A good review of the genus in North America will be found in Poos and Wheeler, 1943. In our fauna, the single representative species can only be confused with *Balclutha*. However, the venation of the tegmina is conspicuously different. The veins run from the base to the cross-veins without forking and are weakly defined basad of the middle.

Empoasca solana DeLong (figs. 7, f; 27).

Empoasca solana DeLong, 1931:50, fig. 10 (male terminalia). Osborn, 1935: 61, fig. 27, *a–c*.

The bean leafhopper (amaranth jassid, in local literature).

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii.

Immigrant. A widespread North American pest. First found in the Territory by Ehrhorn at Honolulu in 1918 at a light.

Hostplants: amaranth, beet, blackeye bean, castor bean, celery, celtuce, cowpea, *Datura,* eggplant, garden bean, lettuce, lima bean, melon, papaya, peanut, potato, summer squash, Swiss chard, tomato, watermelon, yellow cosmos.

This green, transparent-winged leafhopper is one of our most important bean pests, and it has been reported damaging eggplant, peanuts, lettuce and other truck crops. It feeds principally on the undersurfaces of the leaves and causes "burning," yellowing, stippling and shriveling. It frequently becomes excessively abundant and artificial control must be resorted to to save the crops attacked. Beans are most severely attacked in hot, dry, lowland areas. It has not been proved to carry any plant diseases in Hawaii as yet.

Control: Spraying with Bordeaux mixture has been used with some success, but sulphur dust or a pyrethrum–sulphur dust is more highly recommended and has given good control. Satisfactory control is also reported from the use of pyrethrum–talc dust.

Subfamily JASSINAE

Bythoscopidae Dohrn, 1859.

Bythoscopinae, of authors.

This subfamily is not represented by endemic species in Hawaii, although some of our native leafhoppers formerly were placed here. The one immigrant species is easily distinguished from all our other leafhoppers because of the numerous small spines on the tegmina. The more fundamental character, however, is the comparatively deeply set bases of the antennae which are narrowly covered above by an "antennal ledge." The head is very broad with a short vertex, and the pronotum is strongly striolated transversely. Some of our *Nesophryne* may be confused with this subfamily, but the characters outlined in the key and under *Nesophryne* will serve to separate the groups.

Genus **STRAGANIA** Stål, 1862

This is a widespread genus represented in our Territory by a single immigrant species. The combination of the pronotum being broader than the head across the eyes and the conspicuous elytral setulae will serve as a ready means of separating it from the other genera of the subfamily in Hawaii.

Bythoscopus has been used for this group in Hawaii. The two species *Bythoscopus viduus* Stål and *Bythoscopus peregrinans* Stål were reported from Hawaii in error in the "Eugenie's Resa." (See Stål, 1859.)

Subgenus **Penestragania** Beamer and Lawson, 1945

Stragania robusta (Uhler) (fig. 6).

Pachyopsis robustus Uhler, Bull. U. S. Geol. Geog. Survey 3:467, 1877 (I have not seen this reference).

Bythoscopus robustus (Uhler) Osborn, 1935:12.

Stragania (Penestragania) robusta (Uhler) Beamer and Lawson, 1945:53, pl. 1, figs. 1, 1a.

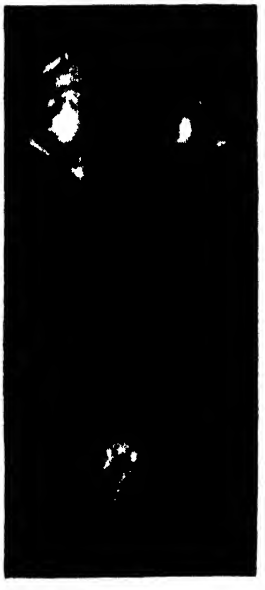

Figure 6—*Stragania robusta* (Uhler).

Oahu, Molokai.

Immigrant. A North American species common from Florida to California. First found by Swezey at Kawela Bay, Oahu, in 1933.

Hostplants: *Ambrosia artemisiaefolia* (ragweed), Bermuda grass, *Prosopis* (algaroba), *Scaevola frutescens.*

In our fauna, this is a distinct species. Perhaps the most outstanding character is the conspicuous dark spines which cover the pale-greenish or yellowish fore-wing membrane. It is between 4 and 5 mm. in length. I have not examined any nymphs. The adults are attracted to lights.

Subfamily EUSCELINAE

This is the largest subfamily of jassids, and it is the only one represented by native species in Hawaii.

With the exception of *Deltocephalus, Balclutha* and *Nesolina,* which feed upon grasses, all of the other representatives of the group found in Hawaii feed upon shrubs or trees.

The following combination of characters serves to distinguish our species from the other subfamilies now found in Hawaii: ocelli at the apices of the frontal sutures and between crown and front, not on crown; lora and genae broad and flat; antennal ledges obsolete and antennal depressions shallow; with the exception of *Balclutha* and *Nesolina,* which may have partially reduced tegminal venation, the venation of the tegmina is complete; there is a membranous "appendix" along the inner margin of the tegminal membrane. With the exception of *Balclutha,* which are pale green or yellowish species without tegminal marking, the other species have prominent color patterns and many are beautiful and striking in color and pattern.

Our species of *Nesophryne* might be confused with the Jassinae because of their broad heads, short crowns and strongly striolated pronota, but the character of the insertions of the antennae will separate the groups. The slender, pale *Balclutha* might be confused with *Empoasca* in the Typhlocybinae, but the more complete

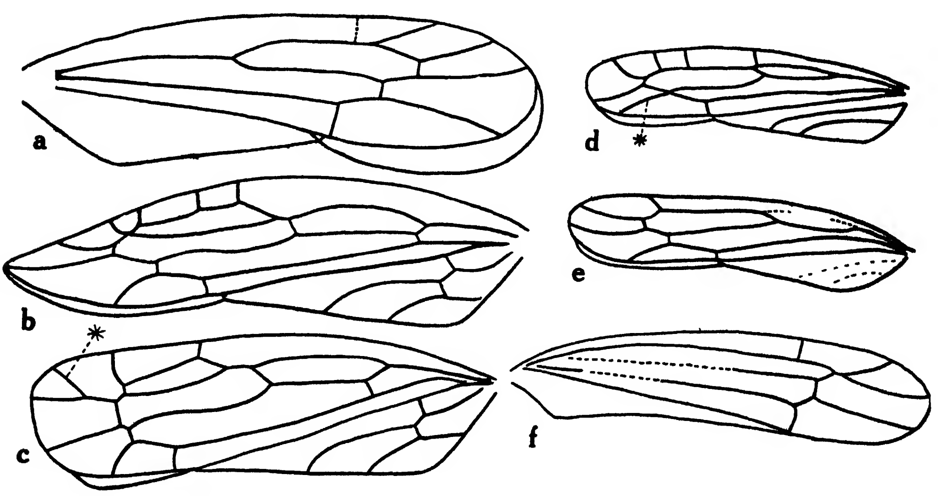

Figure 7—Diagrams of wings of some Cicadellidae: **a**, right tegmen of holotype female of *Balclutha kilaueae* (Kirkaldy) (claval veins omitted); **b**, left tegmen of *Kirkaldiella ewana* Osborn, from the type series; **c**, left tegmen of *Kirkaldiella euphorbiae* Osborn, from the type series (vein marked with asterisk may or may not be present, thus altering the number of apical cells); **d**, left tegmen of *Nesolina lineata* Osborn, from the type series (vein marked with asterisk may be absent); **e**, left tegmen of *Balclutha timberlakei* (Osborn), paratype; **f**, right tegmen of *Empoasca solana* DeLong (claval veins omitted).

tegminal venation plus the presence of an appendix on the tegminal membrane will serve to distinguish *Balclutha.* Also, on *Balclutha,* the tegmina overlap strongly behind and on the hind margin there is a distinct angle formed by the junction of the clavus and membrane as the illustrations show.

Key to the Genera of Euscelinae Found in Hawaii

1. Pronotum coarsely and conspicuously transversely striolate; head broad, crown usually short and broad; comparatively stout, heavy species to very stout species.. **Nesophryne** Kirkaldy.
   Not such species.. 2

2(1). Fore wings with three anteapical cells (check carefully; the outer anteapical cell may be small and obscured by coloring) 3
   Fore wings with two anteapical cells.................... 6

3(2). Outer anteapical cell (often much reduced in size) well isolated from outer apical cell and normally connected to it by a longitudinal vein which is usually longer than breadth of outer apical cell (see fig. 9, center).. **Nesophrosyne** Kirkaldy.
   Outer anteapical cell not so formed, but broadly joining outer apical cell (see fig. 9, top)...................... 4

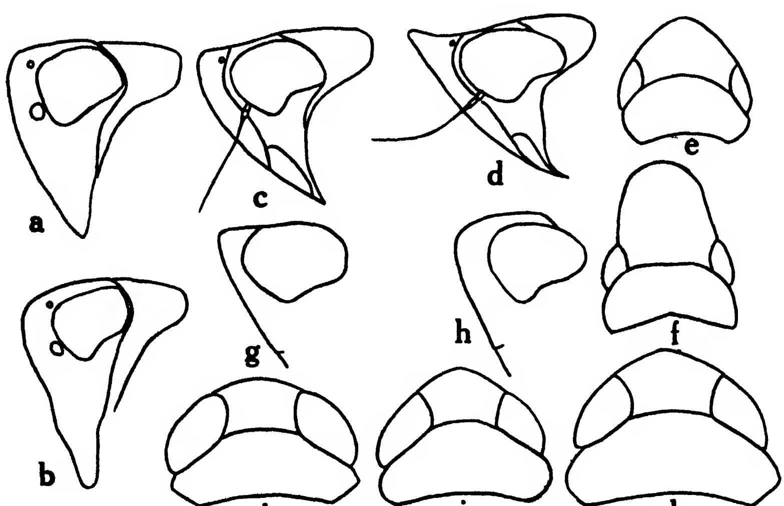

Figure 8—Outlines of heads of some Cicadellidae: **a,** *Nesophrosyne pipturi* Kirkaldy: **b,** *Nesophrosyne gouldiae* Kirkaldy; **c,** *Kirkaldiella ewana* Osborn, paratype; **d,** *Kirkaldiella euphorbiae* Osborn, paratype; **e,** *Nesolina lineata* Osborn, adult; **f,** *Nesolina lineata* Osborn, nymph; **g,** *Nesophrosyne signatula* Osborn, holotype; **h,** *Nesophrosyne notatula* Osborn, holotype; **i,** *Nesophrosyne perkinsi* (Kirkaldy), cotype; **j,** *Nesophrosyne ponapona* Kirkaldy, cotype; **k,** *Nesophrosyne pipturi* Kirkaldy, cotype (?).

4(3). Vertex broadly rounded (in anterior outline as viewed from above), short, very little longer at middle than near eyes, only about one-half as long as pronotum; green species ....**Opsius** Fieber.

Vertex rounded, pointed or roundly pointed in front, but distinctly longer at middle than at sides and at least three-fourths as long as pronotum.................... 5

5(4). Vertex broadly rounded or roundly pointed (then extensively and broadly depressed behind the thin apical margin), but not sharply pointed; tegmina densely opaque and with numerous pale spots............... ....**Kirkaldiella** Osborn.

Vertex prolonged and sharply pointed, not strongly depressed behind fore margin; tegmina subhyaline, not pale-spotted...................**Deltocephalus** Burmeister.

6(2). Fore wings with two discal cells..................... ....**Nesophrosyne** subgenus **Nesoreias** Kirkaldy.

Fore wings with only one discal cell..................... 7

7(6). Head, as measured from directly above, equal or subequal in length along median line to median line of pronotum, conspicuously pointed........... .....**Nesolina** Osborn.

Head rounded or roundly pointed and obviously shorter along median line than pronotum......**Balclutha** Kirkaldy.

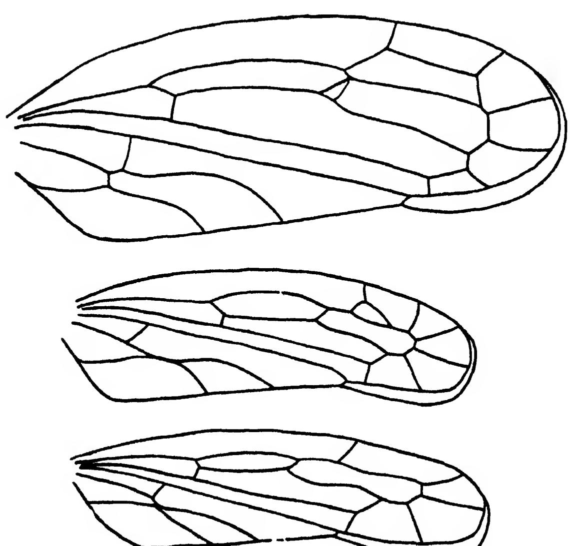

Figure 9—Outlines of tegminal venation of *Nesophryne kaiamamao* (Kirkaldy), top; *Nesophrosyne* (*Nesophrosyne*) *perkinsi* (Kirkaldy), center; and *Nesophrosyne* (*Nesoreias*) *insularis* Kirkaldy, bottom.

Genus **NESOPHRYNE** Kirkaldy, 1907a:160

This is an endemic genus which Kirkaldy (1907:160) said was "Allied to *Eutettix,* but the habitus is quite different, and the vertex much shorter, more declivous, with the eyes scarcely so wide as the transversely striolate pronotum." In 1910 (p. 556) Kirkaldy gave an expanded description. Osborn (1935:8–9) gave no other notes on the relationships of the genus. *Eutettix* and other allied genera occur in the islands southwest of Hawaii. W. E. China has recently examined the genus for me and writes that it seems to have been "derived from *Goniagnathus* Fieb., a genus widespread in Europe and Asia . . ." I have found the male genitalia to be of the same type as *Nesophrosyne* and *Kirkaldiella.* In fact, I do not see how these three genera can be separated on the basis of their genitalia. The venation of the tegmina is similar to that of *Kirkaldiella.* Perhaps all three genera have sprung from the same basic stock.

It is remarkable that most of the species of this group (considering the undescribed species, too) so closely resemble *Bythoscopus* yet belong to a distinct subfamily. They are our only native species to have coarse transverse striolations on the pronotum.

The described species are from Kauai, but I have seen new species from Oahu, Lanai and Maui, and these include the most divergent forms.

Two species were described by Kirkaldy (1902:114–115) in *Bythoscopus,* but when he described *Nesophryne* (1907:160) and later (1910:557) when he added a new species, he did not have access to the types of the two species described under *Bythoscopus* and suggested that he might have redescribed those species. Osborn (1935:8) thought that he had identified three of Kirkaldy's four "species" among the fairly large number of specimens examined by him, but he was misled by the literature.

In Perkins' letter (January 31, 1922), referred to above, he stated:

> *Nesophryne.* I cannot furnish any information as to types of this genus. The types of *kukanaroa* and *kaiamamao* ought to be in the B[ritish] M[useum] as apparently K[irkaldy] did not have them in Honolulu. *Filicicola* and *microlepiae* should be amongst Giffard's specimens, but I doubt whether K[irkaldy] labelled these distinctively, as he had no need to send them back to England like the others. Types from my collection he evidently partly labelled as such [by attaching pieces of red paper] but at the time he knew it was my intention to send these back with those belonging to the "Sandwich Is. Committee." One or two specimens of *Nesophryne* (as I suppose) in my collection were not named at all by him.

With these valuable notes to guide me, I have been successful in finding Kirkaldy's holotype specimens in Giffard's material at the Bishop Museum. As Perkins surmised, they bear no type labels. I have labeled these specimens as the holotypes and have placed them in the type collection at the Bishop Museum. Three nymphs of *filicicola,* including the one mislabeled "Kilauea, Hawaii," instead of "Kilauea, Kauai," as noted by Kirkaldy in his original description, have been placed with the holotype.

A comparison of these types, *filicicola* and *microlepiae,* has led me to consider them to be synonyms as is indicated later in the text. Kirkaldy described *microlepiae* a few years after *filicicola,* and he said (1910:557), "This may be only a dark var. of the preceding [*filicicola*], but I do not think so." The type of *microlepiae* is closely similar to that of *filicicola*, but it has the dark maculations intensified so that it is considerably darker than *filicicola,* but the color pattern is essentially duplicated. The type of *filicicola* may be a teneral individual. I have examined the external male terminalia and find that they are alike, as the illustrations indicate. In the series of specimens of the various species which I have examined there is considerable variation in color and intensity of the color, and it appears that the difference in color of the two types comes within the range of variation for a single species. The two names are therefore considered to apply to one species, and these in turn fall as synonyms of *kaiamamao.*

Osborn's description of the male terminalia of *filicicola* is erroneous. I have the specimen before me from which he evidently drew his description. It is not *filicicola* but appears to be *kukanaroa,* a species not recognized by Osborn amongst the material he examined. Osborn described the male terminalia of *filicicola* as follows: "valve small, triangular; plates triangular, tips acute." From a glance at the figure of the terminalia of the type of *filicicola* presented here, it will be obvious that

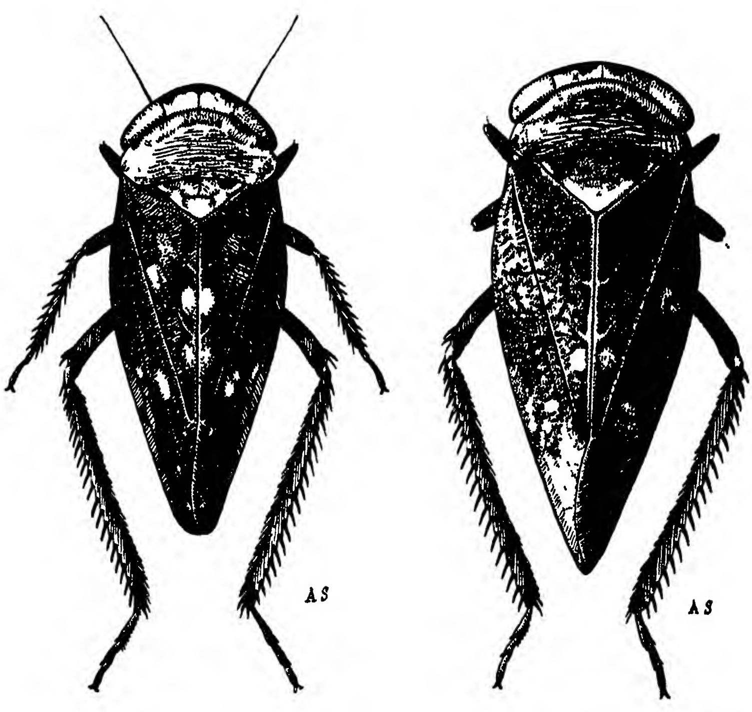

Figure 10—*Nesophryne kaiamamao* (Kirkaldy), holotype, left; *Nesophryne kukanaroa* (Kirkaldy), holotype, right. (Drawn at the British Museum of Natural History by Smith.)

Osborn described the terminalia of a different species. The terminalia of the specimen confused with *filicicola* are illustrated here under the name of *kukanaroa*.

The specimens of the several species of the genus examined by me have been taken on *Elaeocarpus*, *Myrsine* (*Suttonia*), *Cheirodendron*, *Osmanthus* and evidently other unidentified trees.

The nymphs are stout creatures and do not have numerous long bristles on the abdominal tergites.

Key to the Species of Nesophryne

1. Male with head as viewed from directly above with front margin bluntly pointed and projecting distinctly beyond anterior margin of eyes, as illustrated; hind margin between inner corners of eyes only slightly longer than greatest chord of an eye (1.5 : 1.3); when viewed from side, front and vertex form an angle.......................**kaiamamao** (Kirkaldy).

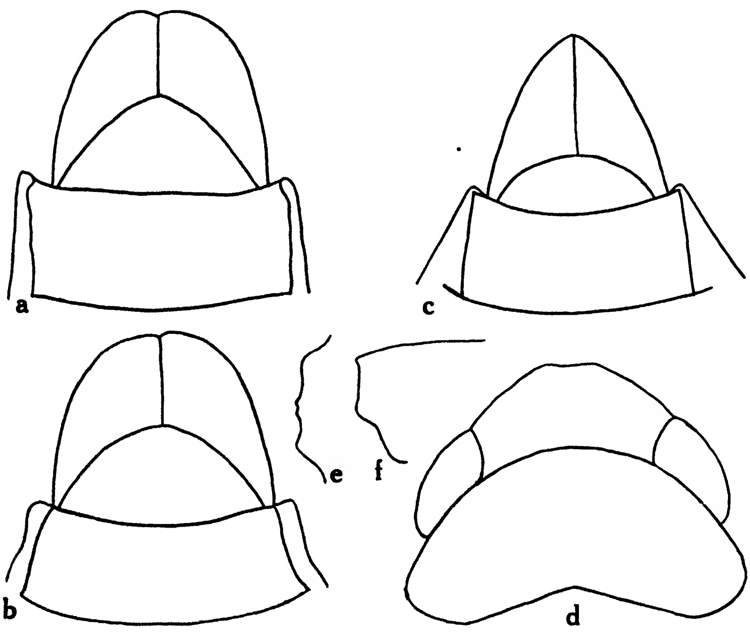

Figure 11—Details of Cicadellidae: **a**, ventral view of male terminalia of *Nesophryne kaiamamao* (Kirkaldy) (from the type of *microlepiae* Kirkaldy, and here considered the same as *filicicola*—compare with **b**); **b**, the same of the type of *Nesophryne filicicola* Kirkaldy (now a synonym of *kaiamamao*); **c**, the same of *Nesophryne kukanaroa* (Kirkaldy); **d**, head and pronotum of *Balclutha kilaueae* (Kirkaldy), holotype female (the head appears unnaturally blunted, but it is variable in shape); **e**, outline of last ventral segment of *Balclutha kilaueae* (Kirkaldy), holotype, from directly beneath; **f**, the same in side view. (Contours in **e** and **f** are somewhat variable, especially the median point.)

2. Male with front margin of head broadly and flatly arcuate and hardly projecting forward of eyes, as figured; hind margin between inner corners of eyes much longer than greatest chord of an eye (2: 1.5); when viewed from side, front and vertex not angulate but together forming a broad, smooth curve.............................. **kukanaroa** (Kirkaldy).

Nesophryne kaiamamao (Kirkaldy) (figs. 9; 10; 11, a, b; 14, d).

Bythoscopus kaiamamao Kirkaldy, 1902: 115.

Nesophryne kaiamamao (Kirkaldy) Kirkaldy, 1910:557. Osborn, 1935:10.

Nesophryne filicicola Kirkaldy, 1907a:160. Osborn, 1935:9. Genotype. New synonym.

Nesophryne microlepiae Kirkaldy, 1910: 557. Osborn, 1935: 9. New synonym.

Endemic. Kauai (type locality: "high plateau").

Hostplants: *Microlepia strigosa* (not *Gleichenia dichotoma* as reported in the original description; correction of error by Kirkaldy, 1910: 557), *Elaeocarpus bifidus*. It is probable that *Microlepia* is not a hostplant.

The holotype is in the British Museum, and a drawing of it is presented herewith.

Nesophryne kukanaroa (Kirkaldy) (figs. 10; 11, c).

Bythoscopus kukanaroa Kirkaldy, 1902: 114.

Nesophryne kukanaroa (Kirkaldy) Kirkaldy, 1910: 557. Osborn, 1935: 10.

Endemic. Kauai (type locality: Halemanu, 4,000 feet).

Hostplant: *Cheirodendron.*

The holotype is in the British Museum, and it is figured here.

Genus **KIRKALDIELLA** Osborn, 1935:13

This genus was described to receive two Hawaiian species and is endemic. Osborn thought it resembled or was allied to the non-Hawaiian genera *Eutettix, Mesamia* and *Megabyzus*. However, he stated (1935:17) that *Nesophrosyne halemanu* Kirkaldy and *Nesophrosyne haleakala* Kirkaldy ". . . seem to be somewhat intermediate between the species of *Kirkaldiella* and *Nesophrosyne* as the head is more flattened and the vertex margin sharper than in those species, but the outer anteapical approaches the form common in *Nesophrosyne*." It appears to me that *Kirkaldiella* is a local offshoot of *Nesophrosyne*. The male genitalia are similar to *Nesophrosyne* and *Nesophryne*.

The two included species differ from each other in several conspicuous characters. I do not feel that the generic characters outlined by Osborn entirely fit the second (*ewana*), and the formation of the vertex of the head, as used by Osborn in his key to the genera of Jassinae (p. 13) does not apply to *ewana,* although it is applicable to *euphorbiae*.

The nymphs have two rows of long bristles on each side of the dorsum of the abdomen, a feature in common with *Nesophrosyne*.

Key to the Species of Kirkaldiella

1. Median line of vertex of head slightly longer than median line of pronotum; head, in side view as in figure 8, d; tegmina broadly rounded at apex..................**euphorbiae** Osborn.
2. Median line of vertex distinctly shorter than median line of pronotum; head in side view as in figure 8, c; tegmina sharply pointed at apex..............................**ewana** Osborn.

Kirkaldiella euphorbiae Osborn (figs. 7, c; 8, d; 12).

Kirkaldiella euphorbiae Osborn, 1935: 14, fig. 2. Genotype.

Figure 12—*Kirkaldiella euphorbiae* Osborn, paratype, left; *Kirkaldiella ewana* Osborn, paratype, right (tips of wings damaged).

Endemic. Molokai (type locality: Moomomi).
Hostplant: *Euphorbia.*
The types are in the Bishop Museum.

Kirkaldiella ewana Osborn (figs. 7, b; 8, c; 12).
Kirkaldiella ewana Osborn, 1935:15, fig. 3.

Endemic. Oahu (type locality: Ewa).
Hostplant: *Euphorbia multiformis.*
The types are in the Bishop Museum.

Genus **NESOPHROSYNE** Kirkaldy, 1907a:160

Kirkaldy, 1910:558, expanded description.

This native genus is our largest complex of the family. W. E. China is of the opinion that it is a possible derivative of the *Thamnotettix* complex. The tegminal venation is slightly simplified from that of *Nesophryne* and *Kirkaldiella* by the reduction of the outer anteapical cell, and it is further reduced in the subgenus *Nesoreias* in which this cell is lost (see the illustrations). The male genitalia are of the same type as those of *Kirkaldiella* and *Nesophryne*. It would appear that in spite of the different facies of some of the broad species of *Nesophryne* (undescribed) these genera may be much more closely allied than has heretofore been believed and that perhaps they may have come from the same stem.

Prof. Dwight DeLong has given me the following note on a comparison of the male genitalia: "The genus *Scaphoideus* has male plates which are elongated and rounded at the tip. The genus *Osbornellus* has plates which are long, tapered to filamentous tips which are covered with spines. The plates of *Nesophrosyne* are like those of *Osbornellus*. The internal genital structures are distinct. The aedeagus is usually Y-shaped in ventral view in *Nesophrosyne* and in all the species which I have examined the apex of each arm of the aedeagus is bent shortly with a slender terminal process. This seems to be characteristic of the genus. . . . I consider these two genera distinct."

In spite of the fact that 62 forms have been described, the genus is comparatively poorly known, and I believe that it includes well over 100 species. No key has been written to separate the species. It is a difficult group. Kirkaldy (1910:558) said, "This gĕnus—*Nesophrosyne*—is the most difficult of the Hemipterous genera of these islands to deal with specifically. It is impossible in some instances, from the material before me, to say whether certain forms are species or only local varieties. A much more adequate material, a knowledge of the range of variation, of the foodplants, and of the nymphs, is necessary before the synonymy can be settled. The variation in some forms known to me is quite bewildering." The difficulties

now facing the student who wishes to identify his collections are great in spite of the fact that only Kirkaldy and Osborn have described the known species. The genus is in need of critical and much more careful study than it has received heretofore.

The nymphs have two rows of conspicuous bristles on each side of the dorsum of the abdomen, and they are often very different one from another and should furnish good characters for separation of the species.

Our native *Nesomimesa* wasps sometimes provision their nests with these leafhoppers. Unidentified *Gonatopus* (Dryinidae) wasps attack some of the species.

I have not recorded full lists of hostplants from series which I have considered might be mixed species. The hostplant relationships of the group are not well known.

Key to the Subgenera of Nesophrosyne

1. Tegmina with three anteapical cells (fig. 9, center)..**Nesophrosyne.**
2. Tegmina with only two anteapical cells (fig. 9, bottom)..**Nesoreias.**

Subgenus **Nesophrosyne** Kirkaldy

The construction of a key to the many described forms of *Nesophrosyne* is a most difficult task. Not only is the genus a confusing natural complex of complexes, but the workers who have described the known species have added not a little to the confusion. Under *Nesoreias* I have noted some of the confusing variation that is encountered in tegminal venation. To one as inexperienced with the leafhoppers as I, the task has been almost overwhelming. I believe that the entire group must be gone over with great care by a skilled, broad-minded, biologist-systematist beginning with a careful revision of the type specimens of all of the known species before

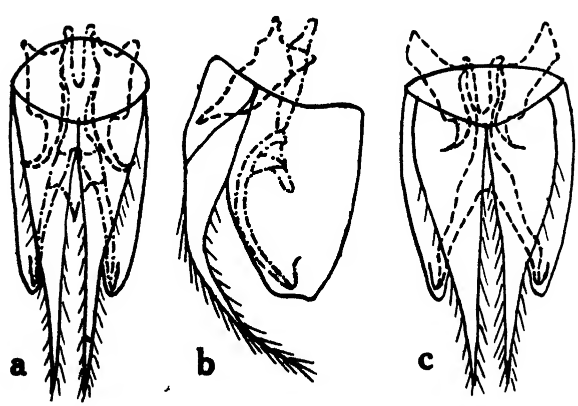

Figure 13—Sketches of male genitalia of *Nesophrosyne*: **a, b**, ventral and lateral views of *N. perkinsi* (Kirkaldy), genotype of *Nesophrosyne;* **c**, ventral view of parts of *N. nuenue* Kirkaldy. (Kindly drawn for me by Dwight DeLong from specimens determined by Osborn and now in the Ohio State University collection.)

we can hope to obtain even a fair understanding of the genus. The internal genitalia of not a single species has been illustrated heretofore, yet today these organs are considered of primary importance to identification by workers on continental faunas. Much confusion is caused by teneral specimens which usually are paler and have color patterns distinct from fully matured individuals. The types of certain species possibly are teneral specimens, and this fact may make the recognition of the species difficult.

In Osborn's text, obviously allied species frequently are separated widely, and there are remarkably few notes on the relationships of the species. Brief summaries explaining how the species were interrelated and how they differed from one another would have saved us many hours of toil. Many of his descriptive comments are almost meaningless, as applied to individual species, or they are generic. The failure to standardize the descriptions so that the same characters were given equal treatment for each species is most confusing, and it makes it difficult or impossible to assemble diagnostic differences from the series of descriptions. Some of his series of specimens (*bicolorata,* and others, for example) obviously contain more than one species. He failed frequently to take into account and describe the variability of color and color pattern and usually arbitrarily described the color and color pattern of a single individual.

None of Kirkaldy's 40 species included in his *Fauna Hawaiiensis* report of 1910 was illustrated, and Kirkaldy's carelessness with the specimens and his failure to designate types properly adds to the difficulties. Osborn's comments on Kirkaldy's report indicate that he also found the report difficult to work with, for he said (1935:5), "It is unfortunate considering this difficulty that Kirkaldy did not make his descriptions more complete and specific so that comparisons would be more satisfactory. Many descriptions he has confined to a few words, referring to some other species for comparison, and, without positive identification for his other species, the description is of course almost valueless. Kirkaldy of course made

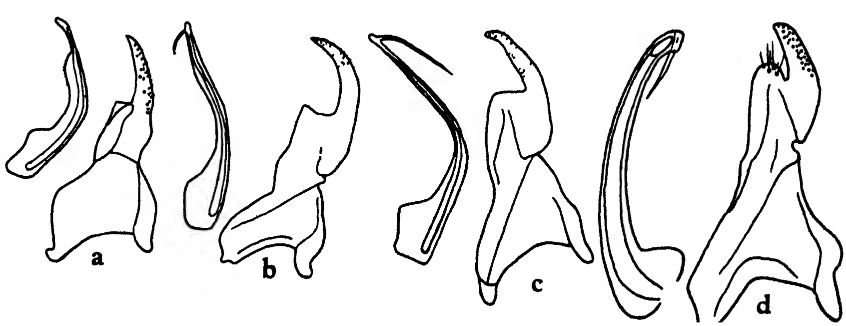

Figure 14—Male genital structures of *Nesophrosyne* and *Nesophryne*: **a**, *Nesophrosyne angulifera* Osborn; **b**, *Nesophrosyne furculata* Osborn, paratype; **c**, *Nesophrosyne peleae* Osborn, paratype; **d**, *Nesophryne kaiamamao* (Kirkaldy). The left figure in each pair of drawings is one arm of the aedeagus, the right figure is a paramere. The drawings were made from glycerine mounts pressed down tightly with a cover slip. The contours of the arms of the aedeagus are somewhat different when seen from the side in their natural positions, and this difference should be allowed for when comparisons are made.

his descriptions from a small number of individuals, many from single specimens representing one sex, or with no evidence concerning the sexes belonging to the same species."

The following key cannot be taken as a final piece of work. It is a first attempt, nothing more. It is, I realize, difficult to use, and it may not work for all species or all specimens of single species. I had been inclined not to include it here, but I have found that it has at least some use and some species can be readily identified by it, and as it may serve as a building block for some future monographer, I have considered its inclusion worth while. In the light of this difficulty, I have written a second series of keys based primarily upon geographical distribution and which follows the main key hereafter and which will be found easier to use for localized lots of material. It is to be regretted, however, that time was not available to enable me to make detailed studies of the genitalia and to incorporate the characters in the keys.

I have, unfortunately, been unable to see authentic specimens of the following six Kirkaldy species and have had to omit them from the key: *nubigena, opalescens, paludicola, silvigena, umbricola,* and *umbrigena* (but see our figures made from the types). All except *umbrigena* and *silvigena* were also unknown to Osborn. I would not rely upon Kirkaldy's descriptions for the identification of these species from our assemblage of unidentified material. Osborn was unable to find the types of any of these species in the British Museum in 1932, but they have been located and drawn for this text at the British Museum. Osborn gave some notes and comments on these species in his 1935 report and redescribed what he considered representatives of *silvigena* and *umbrigena*. The series of specimens returned by Osborn to the Bishop Museum under the name *silvigena* contains several species and cannot be relied upon. The material I have had before me possibly contains a few species which have been misnamed, and these, if any, will cause confusion in the key.

Tentative General Key to the Species of Nesophrosyne

(excluding the species listed above)

See also the individual island keys below.

Where membrane is referred to, I mean the spaces between the veins, not just the apical part of the corium.

1. Head with vertex distinctly produced and pointed (see fig. 17 of *lineata*), when measured from side, distance between anterior edge of an eye and apex is about one-half length of an eye, and when measured from directly above, the distance between middle of base to a line drawn between apices of eyes is about equal to or shorter than length of vertex beyond this line; vertex with a narrow, white, median vitta bounded on each side by a broad, dark vitta in all species excepting *angulifera*...... 2

Head not so formed, vertex shorter and more rounded, although pointed in some forms, when measured from side the distance beyond fore edge of an eye is distinctly less than one-half of length of an eye, usually about one-third or less, and when measured from directly above, the distance between middle of base and a line drawn between anterior edges of eyes is greater than length from this line to apex of vertex; vertex rarely with such a color pattern as above.............. 5

2(1). Face with grill of dark transverse lines conspicuous; vertex without a pale median vitta bounded on either side by a dark vitta..................**angulifera** Osborn.

Face without a grill of dark lines; vertex with a narrow, pale, median vitta bounded on either side by a broad, dark vitta 3

3(2). Costal margin almost entirely pale, adjacent membrane mostly hyaline or subhyaline excepting at apex and on cross-veins..........................**albicosta** Osborn.

Costal margin and adjacent membrane almost entirely dark colored 4

4(3). Abdominal ventrites mostly black..........**lineata** Osborn.

Abdominal ventrites with broad bands of yellow or largely yellow ....**affinis** Osborn.

5(1). Head comparatively peculiarly formed when viewed from side or in front, appearing longer and more nearly vertical than is usual for the genus (fig. 8, b); face measured from top of apex of vertex to apex of clypeus (as seen from front) longer than greatest distance across head (including eyes) as measured from front (host-plant *Cyrtandra*)............ ....**gouldiae** Kirkaldy.

Head not so formed....... 6

6(5). Wings and pronotum pale and densely flecked with minute, dark specks but without prominent maculae and without prominent, dark-colored veins except toward apex 7

Wings without such dense, minute flecks, usually with dark maculae and/or dark veins, or, if pale, never flecked as above.................................... 8

7(6). Vertex flattened and forming a distinct angle with front, as in figure 8, g, as seen from side.......**signatula** Osborn.

Vertex rounded off into front as seen from side, as in figure 8, h...........................**notatula** Osborn.

8(6). Undersurface, including pleura and venter, almost entirely or entirely pale (excluding ovipositor), not colored, not even with narrow dark bands on abdominal ventrites 9

Undersurface partly or largely colored, dark colored or conspicuously maculate, or with broad or narrow abdominal bands, never pale and immaculate............19

9(8). Head, measured from side, with distance from suture between ocellus and an eye to apex of vertex divided into length of an eye equals less than 4...............10

This measurement equals 4.5 or more..................16

10(9). Tegminal membrane without conspicuous dark maculae other than an apical infuscation; dorsum usually pale-yellow or amber colored............................11

Tegmina with distinct dark maculae and in some species with veins conspicuously dark.......................13

11(10). Pronotum obviously broader than head across eyes; tegmina with rather obscure white patches.....**ehu** Kirkaldy.

Pronotum subequal in breadth to head..................12

12(11). Vertex, as viewed from side, distinctly concave; last ventral segment of female very slightly, hardly concave on sides............................**cuprescens** Osborn.

Vertex not concave, rounded off to front; last ventral segment of female deeply concave on each side....... .... **ignigena** Kirkaldy.

13(10). Tegminal veins mostly conspicuously dark from base to apex, even those on clavus largely dark, and making a characteristic and outstanding dark, net-like pattern.. .... **furculata** Osborn.

Tegminal veins not so colored, sometimes partly dark, but never so conspicuously so as above...............14

14(13). Tegminal membrane not milky and without distinct milky spots, more yellowish or transparent amber in color and typically with only the following dark maculae: tip of clavus dark, costal margin with a brown blotch about midway between base and nodus where there is a similar blotch, bounding veins of outer apical cell embrowned and dark color extending over most of next to outer apical cell; pronotum dark on either side or over most of disc...................**touchardii** Osborn.

Tegmina not as described above, membrane largely milky or with distinct milky spots and typically with more brown maculae 15

15(14). Hind wings moderately transparent and with dark veins; tegminal membrane and veins tinged with brown..... .... **ponapona** Kirkaldy.

Hind wings usually milky white, opaque, veins largely pale; tegmina distinctly paler (Note: This is very closely allied to the preceding, but it is a paler insect.) ....**pipturi** Kirkaldy.

16(9). Clavus with a conspicuous yellow saddle mark bordered before and behind with black, most of tegminal veins dark colored..........................**mabae** Osborn.

Not such species...................................17

17(16). Tegmina with three or four nodal veins..**maritima** Kirkaldy.

Tegmina with only a single nodal vein.................18

18(17). Very pallid species, usually milky-white above or with a pale-yellowish or brownish tinge, but tegmina always at least with milky areas or spots, although the spots may be obscure (on *Sida*)...........**perkinsi** (Kirkaldy).

Yellowish-brown species with amber-colored tegmina... .... **procellaris** Kirkaldy.

19(8). Median length of vertex divided into extreme breadth of head to outer edges of eyes equals 2.9 or more (measure very carefully with an eyepiece micrometer with vertex level) 20
This measurement equals less than 2.9, usually less than 2.8.. 40

20(19). Pronotum (by actual and careful measurement) slightly but distinctly and measurably broader than greatest breadth of head across greatest convexity of eyes (not at their hind edges) 21
Pronotum narrower, about as broad as head across eyes, or just perceptibly broader, but not obviously broader (an optical illusion may confuse one into thinking that it is distinctly broader owing to the narrowing of the hind edges of the eyes, so measure carefully) 24

21(20). Most or all of veins of tegmina individually mostly distinct and dark colored and forming a conspicuous reticulate pattern overall (a small slender species) .... **montivaga** Kirkaldy.
Few or none of veins separately dark colored and not forming such a pattern, and not especially distinct individually 22

22(21). Legs extensively dark or infuscated, especially femora; tegmina normally with a very conspicuous yellow saddle mark margined by black and with beautiful purplish-coppery reflections when rotated against light .... **myrsines** Kirkaldy.
Legs, excepting posterior tibiae, entirely pale; tegmina without a distinct saddle mark 23

23(22). Head with a pale median vitta bounded on each side by a dark stripe; tegmina extensively dark or black with costal area subhyaline or milky-white .... **umbratilis** Kirkaldy.
Head not so colored, irregularly maculate; tegmina with dark maculae, but not extensively dark; costal area not subhyaline or white much before middle and with a large dark macula before middle .... **sinuata** Osborn.

24(20). Vertex conspicuously depressed behind apex (a Kauai species with a simple reticulate pattern on tegmina formed by dark veins) .... **halemanu** Kirkaldy.
Vertex not so formed, usually obviously convex, but flattened in some species 25

25(24). Tegmina with a distinct and conspicuous color pattern which consists principally of numerous dashes of dark brown on yellow membrane with veins pale colored except caudad .... **pele** Kirkaldy.
Tegmina not so colored 26

26(25). Tegmina with nearly all of color pattern made up by usually very conspicuous dark-colored veins on a greenish-yellow background or infuscations on veins but with some small dark areas in some cells or on clavus, but without a conspicuous saddle mark 27

Tegmina either with extensive dark maculations or without such dark-colored veins or with a distinct saddle mark 29

27(26). Tegmina with three or four nodal veins..nimbigena Kirkaldy.

Tegmina with only a single nodal vein.................28

28(27). Median length from fore edge of vertex to apex of scutellum (excluding the apical spine) divided into length of tegmina equals about 2.6.............**bobeae** Kirkaldy.

Median length from apex of scutellum to apex of vertex divided into length of tegmina equals about 3.0.. **silvicola** Kirkaldy.

29(26). Tegmina with costal area hyaline, or hyaline and partly whitish from almost at base nearly to apex; clavus typically greenish-yellow, area between this and pale costal area dark; clavus without a diagonal dark mark across greenish-yellow membrane.......**giffardi** Kirkaldy.

Tegmina with a different color pattern, if costal area is paler than surrounding membrane, it is less extensively so than above 30

30(29). Tegmina with color pattern somewhat similar to *giffardi,* as described above, but with clavus with a conspicuous dark band along base which obliquely crosses greenish-yellow background dividing it into two pale maculae; occasionally dark color is restricted to oblique mark and is not present along base of clavus.......................................**giffardi interrupta** Osborn.

Color pattern of tegmina distinct from that described above 31

31(30). Almost entirely black species; tegmina usually with a yellow saddle mark and a few pale or subhyaline spots behind middle..........................**milu** Kirkaldy.

Not black species....................................32

32(31). Tegmina amber-colored or tinged with reddish, without a saddle mark and not otherwise distinctly maculate....33

Tegmina maculate and usually with a conspicuous saddle mark 35

33(32). Pronotum and clavus extensively and conspicuously red .... **palustris** Kirkaldy.

Not so, largely amber-colored above....................34

34(33). Front of head without a transverse dark band below ocelli ....**ulaula** Kirkaldy.

Front with a continuous dark transverse band just below ocelli.....................**ulaula nigrolineata** Kirkaldy.

35(32). Vertex black, pronotum, excepting anterior margin, yellow; each element of the yellow saddle mark elongate-triangular and extending to less than one-half its length from claval apex; area in front of bright saddle mark with coppery reflections; an unusually bright-colored species...................**nimbicola** Kirkaldy.

Not so colored, vertex usually not much darker than pronotum, or saddle mark is broader and does not extend so near to claval apex............................36

36(35). Veins of tegmina conspicuously dark colored and tegmina with few to several white maculae in cells behind middle . 37
Tegminal veins not mostly distinctly darker than membrane, or only partly so or largely masked by equally dark or darker membrane 38
37(36). Saddle mark hardly if any longer than length of pronotum . . . . **monticola** Kirkaldy.
Saddle mark about twice as long as length of pronotum . . . . **mabae** Osborn.
38(36). Saddle mark of tegmina open, more or less C-shaped or broken and inconspicuous, not bordered by black . . . . **imbricola** Kirkaldy.
Saddle mark of tegmina solid, bordered at least partially before and behind by black 39
39(38). Vertex and pronotum extensively black, tegmina with extensive black areas . . . . **myrsines** Kirkaldy.
Vertex and pronotum largely pale, tegmina with only limited dark area; a rather brownish-orange species . . . . **oreadis** Kirkaldy.
40(19). Pronotum (by careful measurement) slightly but distinctly broader than greatest breadth of head across eyes . . 41
Pronotum narrower, about as broad, or hardly perceptibly broader than greatest breadth of head, but never obviously broader 43
41(40). Dorsum with an extensive amount of continuous dark or black coloring; tegmina with a strongly contrasted, yellow saddle mark (variable in extent) . . . . **pluvialis** Kirkaldy.
Dorsal color pattern not as above; tegmina without a distinct saddle mark, only veins and scattered maculae dark colored 42
42(41). Clypeus and lora almost or entirely dark; tegmina with extensive dark coloring in discal and adjacent cells . . . . **montium** Kirkaldy.
Clypeus and lora at most each with a dark apical spot; tegmina without such extensive dark coloring . . . . **ponapona** Kirkaldy.
43(40). Vertex distinctly, broadly depressed before apex, distinctly concave in longitudinal outline when viewed from side 44
Vertex not so formed, usually distinctly convex, but flattened in some forms or obscurely depressed, but never distinctly so 45
44(43). Tegminal veins all or nearly all conspicuously dark colored . . . . **haleakala** Kirkaldy.
Tegminal veins almost entirely pale . . . . **palolo** Osborn.
45(43). Membrane of tegmina extensively dark with large areas continuously dark or black and with or without a yellow saddle mark 46
Tegmina not extensively dark, excepting veins and local infuscations and without a saddle mark 49

46(45). Clavus extensively yellow, dark only at apex. . **peleae** Osborn.
Clavus dark at base as well as apex or more extensively dark colored 47

47(46). Dorsum extensively dark or black; tegmina without a pale saddle mark .... **bicolorata** Osborn.
Clavus with a distinct yellow area or saddle mark 48

48(47). Yellow area of clavus distinctly elongate, extending from base nearly to apex, clavus usually dark only outwardly at base and at apex, at least without a saddle mark as described below for *koleae* (the species confused with *myrsines* by Osborn; see discussion under *myrsines*) . . . . species ?
Clavus with a subrounded, well-defined yellow saddle mark which is ringed with dark color and is normally well isolated from base of clavus .... **Nesoreias koleae** (Kirkaldy).

49(45). Tegminal veins all or nearly all, including those on clavus, conspicuously dark colored and forming a conspicuous, somewhat net-like pattern 50
Tegminal veins mostly pale, those on clavus never conspicuously dark colored 52

50(49). Legs and face mostly pale .... **furculata** Osborn.
Legs and/or face with extensive dark coloring 51

51(50). Lanai species with tegmina predominantly yellowish-brown between veins .... **oneanea** Kirkaldy.
Maui species with tegmina clear or grayish between veins, wings showing through to add to the grayish or whitish cast .... **cinerea** Osborn.

52(49). At least hind tibiae with dark spots or dark coloring, femora usually partly dark 53
Legs quite pale, without conspicuous dark areas 54

53(52). Tegmina each with a large distinct milk-white blotch (sometimes yellowish-white) at about middle of corium (really a blend of three spots in adjacent cells), and some milk-white spots above these on clavus........ .... **obliqua** Osborn.
Tegmina without any such spots...... **oneanea** Kirkaldy (?)

54(52). Vertex broadly arcuate in front as illustrated (fig. 19 of *nuenue*) 55
Vertex more roundly pointed than arcuate (fig. 21 of *touchardii*) 56

55(54). Outer anteapical cell reduced, only about one-half as broad as narrowest part of adjacent anteapical cell, a single nodal arising from near its base. (Note: There is only one example under this name at the Bishop Museum, identified by Osborn, and it may not be correctly named.) .... **craterigena** Kirkaldy.
Outer anteapical cell well developed, about as broad as narrower part of adjacent anteapical cell, usually (always?) with two nodals............... **nuenue** Kirkaldy.

56(54). Tegmina with a small but prominent dark spot on nodal from outer anteapical cell, but without dark areas cephalad of this .... **oneanea** Kirkaldy (?)

Tegmina with one or more dark spots or blotches anterior to nodal dark patch 57

57(56). Pronotum with a large, variable dark blotch on each side; tip of clavus dark .... **touchardii** Osborn.

Pronotum without such a dark colored patch .... **caelicola** Kirkaldy.

The following set of keys has been broken up according to island. Our knowledge of the distribution of the species is incomplete, and some confusion may result if representatives of certain species are found in new localities. However, these keys should be of aid in placing most of the described species, but it should not be assumed that because a specimen runs to a particular name in the key that it is automatically correctly identified. Further careful checking often may be needed, and there is no substitute for accurately named specimens to use for final comparison. The keys will serve, however, to eliminate many species from the list of possible name assignments.

Island Keys for the Separation of the Species of Nesophrosyne

KEY TO THE KAUAI NESOPHROSYNE

Although only three species have been recorded from Kauai, I have collected or examined probably a dozen or more species from that island, most of which appear to be new.

1. Face entirely pale; vertex black with a yellow median line; pronotum black; tegmina largely black with pale longitudinal maculae on clavus, some pale spots distad on clavus, and costal margin broadly pale from near base to near apex; a slender species .... **umbratilis** Kirkaldy.
2. Face with much dark coloring, clypeus dark, front with grill dark and distinct; vertex depressed behind apex, mostly pale, with a fine, dark median line which expands slightly just before apex, and a pair of subapical dark spots and a similar but less well-defined pair of dark subbasal spots; pronotum mostly pale; tegmina basically pale with contrasting dark (brown) veins, apices dark, and with some variable dark marks elsewhere, but veins outstanding; a stout species .... **halemanu** Kirkaldy.
3. Pale ferrugineous, face black, color encroaching on vertex, grill only visible at sides, ferrugineous, sterna (entirely ?), femora (except apically) blackish, hind tibiae striped longitudinally with black, bristles pale ferrugineous; membrane clouded with black inwardly (from original description; I have not seen this species, but see fig. 22, a) .... **silvigena** Kirkaldy.

KEY TO THE OAHU NESOPHROSYNE

(20 forms)

(*N. opalescens* omitted, but see fig. 18.)

1. Vertex strongly pointed, produced, distance along median line from line drawn between fore edges of eyes to apex about as long as distance from this line to base, median line pale, expanded slightly distad, flanked on either side from base to apex by a nearly black vitta, which occupies entire area between median line and eye at base, pale outside this vitta; pronotum and scutellum nearly all dark; tegmina mostly dark but with pale costal band from near base to apical cells..**albicosta** Osborn.
   Not such species.................................... 2

2(1). Pale species with vertex, thoracic nota and tegmina almost entirely covered with minute spatter-like flecks of dark color suggesting a dusting of sand, most distinct on tegmina and forming an unusual color pattern for *Nesophrosyne* 3
   Not such species.................................... 4

3(2). Vertex short and broadly rounded, its median length less than three-fourths as long as narrowest interocular breadth ....**notatula** Osborn.
   Vertex pointed, nearly as long as shortest distance between eyes..........................**signatula** Osborn.

4(2). Vertex pointed, produced, with a well-marked transverse depression between anterior edges of eyes; face with grill well-defined; vertex, pronotum and scutellum pale ....**palolo** Osborn.
   Vertex not so depressed in combination with a produced, pointed vertex 5

5(4). Head appearing longer and more nearly vertical than usual for genus (see fig. 8, b); face measured from top of apex of vertex to apex of clypeus (as seen from front) as long or longer than greatest distance across head (including eyes) as measured from front (on *Cytandra*) ....**gouldiae** Kirkaldy.
   Head shorter and broader, usually distinctly broader across eyes than length in front (including frons and clypeus) 6

6(5). Undersurface, including pleura and venter almost entirely or entirely pale (excluding ovipositor).......... 7
   Undersurface partly or largely colored, dark colored or conspicuously maculate or with broad or narrow abdominal bands, never very pale and immaculate........12

7(6). Vertex either depressed behind apex or with a subapical, impressed, transverse line.......................... 8
   Vertex convex, not so impressed subapically........... 9

8(7). Vertex pointedly produced; tegmina with only one nodal vein ....**cuprescens** Osborn.

Vertex short and broadly rounded; tegmina with two or more nodal veins....................**maritima** Kirkaldy.

9(7). Vertex very short, arcuate, only slightly produced beyond eyes...............................**perkinsi** Kirkaldy.

Vertex pointed or roundly pointed, distinctly produced beyond eyes.......................................10

10(9). Tegminal membrane not milky and without distinct milky spots, more yellowish or transparent amber in color and typically with only the following dark maculae: tip of clavus dark, costal margin with a brown blotch about midway between base and nodus where there is a similar blotch, bounding veins of outer apical cell embrowned and dark color extending over most of next to outer apical cell; pronotum dark on either side or over most of disc..................**touchardii** Osborn.

Tegmina not as described above, membrane largely milky or with distinct milky spots and typically with more, brown maculae.......................................11

11(10). Hind wings moderately transparent and with dark veins; tegminal membrane and veins tinged with brown..... ....**ponapona** Kirkaldy.

Hind wings usually milky-white, opaque, veins largely pale; tegmina distinctly pale (Note: This is very closely allied to the preceding, but it is a paler insect.) ....**pipturi** Kirkaldy.

12(6). Pronotum mostly or entirely black or dark brown........13

Pronotum largely pale, never mostly dark...............15

13(12). Vertex mostly yellow, with a narrow, sinuous, subapical transverse dark band; scutellum mostly pale, yellow; tegmina with clavi broadly and conspicuously yellow from base to about apical fourth, thence black, remainder of tegmina black excepting some large pale maculae behind middle; a striking black and yellow species ....**peleae** Osborn.

Without such a color pattern...........................14

14(13). Face dark; clavi with a common, transversely ovate, pale saddle mark at middle which is about as long along median line as pronotum and is very conspicuous to unaided eyes in fully matured examples............ ....**monticola** Kirkaldy.

Face pale; clavi without a saddle mark and almost or entirely dark or black, or rather mottled or irregularly colored in teneral specimens especially..**bicolorata** Osborn.

15(12). Predominantly reddish or brownish-orange species without extensive dark coloring on tegmina and without conspicuous dark veins...........................16

Basically yellowish species, normally with extensive dark coloring on tegmina or with prominent dark-colored veins or both.....................................18

16(15). Clavi with a common, median, white or creamy, subovate saddle mark.........................**oreadis** Kirkaldy.

Tegmina without saddle mark.......................17

17(16). Front of head without a transverse dark band beneath ocelli.................................**ulaula** Kirkaldy.
Front with a continuous, narrow, transverse, dark band just below ocelli............**ulaula nigrolineata** Kirkaldy.

18(15). Tegmina of fully mature specimens with subcostal area hyaline or partly whitish, in any case pale, area between this pale area and clavus black or dark; clavus typically entirely or almost entirely greenish-yellow.. ....**giffardi** Kirkaldy.
Without such a color pattern, veins usually outstanding, at least in part, and making up much of color pattern.. ....**bobeae** Kirkaldy.

KEY TO THE MOLOKAI NESOPHROSYNE

(5 species)

1. Female. Blackish; a yellowish ferrugineous grill on a purplish-brown frons; a whitish spot on pronotum near lateral margins; scutellum sordid whitish, more or less suffused (especially apically) with brownish; tegmina whitish hyaline, claval veins suffused brown, apical angle brown; inner half of corium brownish except a narrow claval margin and one or two apical spots, whitish, exterior half whitish, apical cells mostly brownish; abdomen mostly blackish-brown; hind tibiae blackish-brown, spines white; pygophore pale with pale hairs; ovipositor sheath blackish; length 4.5 mm. (from original description; I do not know the species, but see fig. 18)...............**paludicola** Kirkaldy.
Not such species.................................... 2

2(1). Vertex produced, sharply pointed, depressed behind apex... 3
Vertex short, arcuate, not depressed behind apex......... 4

3(2). Almost entirely dark above; vertex with a pale, narrow median line, thence with a dark vitta on either side from base to apex, its base as wide as distance from median line to eye, but narrowing to apex, and with sides of vertex in front of eyes pale; pronotum for most part dark; tegmina largely dark..............**lineata** Osborn.
Vertex mostly pale with some dark spots; pronotum largely pale; tegmina basically yellowish with prominent dark and pale maculae and dark veins, with some variable coalesced white maculae in usual saddle mark position on clavus and with a cluster of four outstanding rounded white spots in cells arranged as an extension from those on clavus and together with them forming an oblique series across tegmina, with a white spot at apices of inner and middle preapical cells, outer apical cells largely white..................**angulifera** Osborn.

4(2). A stout reddish species; undersurfaces with black coloring............................ **palustris** Kirkaldy.
A slender yellowish species; undersurfaces pale........ .... **procellaris** Kirkaldy.

KEY TO THE LANAI NESOPHROSYNE

(12 species)

(excepting *nubigena* and *umbricola,* but see figs. 18 and 22, b)

1. Vertex strongly pointed, produced, distance along median line from line drawn between fore edges of eyes to apex about as long as distance from this line to base, median line pale and flanked on either side with a dark vitta from base to apex, base of each dark vitta as wide as distance from median line to eye; pronotum and scutellum mostly dark; tegmina dark excepting for some pale spots which are mostly behind middle; a sharp-headed, dark-colored species.........**lineata** Osborn.
Not such species.................................... 2

2(1). Almost entirely black, with a variable yellow saddle mark on clavi, and with a submedian costal hyaline macula and some variable hyaline patches between and behind apex of clavi and costal margin; an unusually dark, striking species with a short, arcuate vertex; some examples with a bluish cast on tegmina.......**milu** Kirkaldy.
Not such dark-colored species.......................... 3

3(2). A beautiful and strikingly colored species; vertex black; pronotum almost entirely yellow, darker only along fore margin, and sharply contrasting in color with vertex; scutellum orange; tegmina largely brownish tinged with orange and in part infuscated, clavi with a large, prominent, elongate, yellow saddle mark; face, legs and venter almost entirely dark............**nimbicola** Kirkaldy.
Not such highly colored species......................... 4

4(3). Tegmina with two or more nodal veins; clavi each with a vague, interrupted, variable, zigzag, dark, longitudinal line in fully mature examples from near base to near apex near inner claval margin enclosing a more opaque area, but often obscure and not or hardly traceable in teneral specimens.....................**nuenue** Kirkaldy.
Tegmina with only one nodal vein and that usually hidden in an infuscation and obscure........................ 5

5(4). Tegmina with a milk-white or yellowish blotch composed of three or four spots in adjacent cells at about middle of corium and with a pair or more of similar patches above those on clavus, entire group arranged in an oblique manner across tegmen, and those on clavus margined anteriorly by black, those on corium abutted caudad by black and with pale patches in cells caudad ....**obliqua** Osborn.
Not such species.................................... 6

6(5). Median length of vertex, carefully measured, divided into breadth of head across eyes at widest point equals nearer 2.5 or 2.6 than 3.0............................ 7
This measurement equals about 3.0 or more than 3.0....... 8

7(5). Veins almost all prominent and dark colored, those on clavi also conspicuous and dark excepting in a vague, variable saddle mark, tegmina thus conspicuously lined .... **furculata** Osborn.
Veins at most only partly or irregularly dark, those on clavi never conspicuously dark.......... **caelicola** Kirkaldy.

8(6). Basal half or more of femora black; each clavus with a variable, open, more or less C-shaped saddle mark; veins not especially prominent.............. **imbricola** Kirkaldy.
Femora pale; veins of coria dark and mostly prominent to apex of tegmina.................................... 9

9(8). Tegmina with a dark subcostal macula just before middle and rather similar to nodal infuscation... **silvicola** Kirkaldy.
Tegmina without a dark patch anterior to nodal infuscation................................ **oneanea** Kirkaldy.

KEY TO THE MAUI NESOPHROSYNE

(6 species)

1. Vertex produced, pointed, concave subapically, median line as long or longer than its narrowest interocular breadth.. 2
Vertex shorter and more rounded, its median line always shorter than its narrowest part between eyes............ 3

2(1). A short, stumpy, abbreviated-winged species; tegmina not or hardly surpassing terminalia, distance from end of clavus to apex distinctly shorter than median length of head and pronotum combined.......... **haleakala** Kirkaldy.
Wings fully developed, length of tegmina beyond apex of clavus distinctly longer than median length of head and pronotum combined; with an oblique series of white maculae from middle of clavus to costal margin...... .... **angulifera** Osborn.

3(1). A predominantly reddish or brownish-orange colored species; dorsum nearly immaculate and veins not dark except apically.......................... **ulaula** Kirkaldy.
Not reddish species, dorsum conspicuously maculate and veins mostly dark.................................. 4

4(3). Vertex short and broad, broadly arcuate (length of median line divided into shortest distance between eyes equals about 1.6); pronotum pale caudad, black cepahalad; tegmina with three or four nodal veins not hidden by infuscation; a large stout species........... **nimbigena** Kirkaldy.
Vertex roundly pointed (length of median line divided into shortest distance between eyes equals about 1.0–1.2); pronotum without a black anterior marginal band; tegmina with nodal veins largely hidden by infuscation; relatively slender forms............................ 5

5(4). Tegmina with an oblique series of white or yellowish maculae from middle of clavus to costal margin, those on clavus bordered anteriorly with dark coloring, those

on corium followed by dark coloring which may be in form of a dark fascia when extensive, this color pattern distinct to unaided eyes..............**obliqua** Osborn.

Tegmina without such a color pattern, a rather grayish appearing species whose tegminal color pattern is largely made up of prominent dark veins on a predominantly pale background..............**cinerea** Osborn.

KEY TO THE HAWAII NESOPHROSYNE

(20 forms)

(excluding *umbrigena,* but see fig. 22, c)

1. Vertex produced and sharply pointed, dorsally shallowly concave, with a narrow, yellow median line which expands at apex and is flanked on either side by a broad black vitta which occupies entire space between median line and eyes at base but narrows forward; pronotum and scutellum almost or entirely dark or black; tegmina, excepting some pale marginal or submarginal maculae from middle caudad, dark or black........**affinis** Osborn.
   Not such species 2

2(1). Tegmina with a striking color pattern consisting of irregular dark longitudinal dashes on pale-yellowish (green when living ?) background on clavi and coria; veins pale or pale yellow except at apex; vertex broadly arcuate, its median length only about three-fourths as long as shortest interocular breadth; vertex, pronotum and scutellum yellowish with variable, restricted dark marks; face dark and grill well developed.. **pele** Kirkaldy.
   Not such species.................................. 3

3(2). Legs partly or largely dark, femora always with dark coloring 4
   Femora entirely pale, legs all pale excepting at most some dark spots or areas on hind tibiae..................... 7

4(3). A predominantly reddish or brownish-orange species, tegmina without distinct color pattern....**ulaula** Kirkaldy.
   Not such concolorous species, but distinctly maculate above, even if reddish or orange in color; tegmina normally with saddle mark......................... 5

5(4). Vertex, pronotum, scutellum and tegmina all with extensive black coloring; saddle mark of tegmina solid and extending entirely across clavi; a predominantly dark but brightly marked species..............**myrsines** Kirkaldy.
   Predominantly brownish-yellow or orange-colored species, black marks restricted or absent................ 6

6(5). Saddle mark of clavi when best developed only a C-shaped line on each clavus, open inwardly, not solid, often obscure......................**imbricola** Kirkaldy.

Saddle mark extending conspicuously and solidly across entire clavus, variably bordered with black in front.. .... **oreadis** Kirkaldy.

7(3). Tegmina with two or more distinct nodal veins, clavi in fully mature examples with a characteristic, narrow, elongate, saddle mark extending nearly from base to apex, its outer edge irregular, more or less scalloped, sometimes edged with black, this black edging then assuming a zigzag course; veins and apices of tegmina in part dark, but otherwise a yellowish species without extensive dark maculae above.......... **nuenue** Kirkaldy.

. Not such species, tegmina normally with a single nodal concealed in an infuscation........................... 8

8(7). Face, sternum and venter of abdomen pale, yellowish or whitish, excluding ovipositor which may be dark and a possible dark median patch on last ventrite and a restricted dark area just above and behind fore coxae, without extensive dark areas........................ 9

Face, sternum and venter of abdomen at least in part with extensive dark or black areas, at least with dark facial markings even if no other dark marks are present......12

9(8). Clavi with a large, conspicuous, solid, somewhat diamond-shaped, yellowish saddle mark, in part edged with black .... **mabae** Osborn.

Without such a saddle mark...........................10

10(9). Vertex, as measured from side, almost half as long from fore edge of an eye to apex as length of eye, rather sharply, roundly pointed.................. **ehu** Kirkaldy.

Vertex shorter, either more arcuate, or as above, but closer to one-third or one-fourth as long as an eye as measured from side.................................11

11(10). Veins of tegmina yellow and none infuscate or dark except at apex and tegmina without dark maculae except at apex, clavus opaque greenish-yellow, corium mostly hyaline............................. **ignigena** Kirkaldy.

Tegmina with veins at least partly dark or infuscate and with small dark maculae on clavus and corium........ .... **craterigena** Kirkaldy.

12(8). Note: The following species are extremely difficult to separate in a key based upon external characters, especially color, because of their variability and the fact that teneral specimens may have quite distinct color patterns from normal, fully matured individuals.

Small, slender species not or barely more than 4 mm. long, all with rather pointed heads, tegmina maculate but without extensive solid black areas...............13

Stouter forms usually at least 4.5 or 5 mm. long, vertex either arcuate or pointed, but if smaller than 4.5 mm. then with solid black areas on tegmina, or dorsa largely black 15

13(12). Tegmina with veins mostly pale, dark only caudad, with dark maculae restricted to a vague humeral mark, tip of clavus dark, apex of corium dark and with a dark

costal patch at about middle, another on nodal vein and a narrower one on vein of outer apical cell, tegmina otherwise almost immaculate and hyaline; face without grill, with only a pair of dark bands between eyes (these may be fused into one band); (these characters are from typical form which may not occur on Hawaii) ....**touchardii** Osborn.

Tegmina with more extensive dark veins and more dark maculations; face with extensive dark coloring.........14

14(13). Genae broadly pale outwardly; costal area of tegmina almost entirely pale, hyaline from base to apical cell, nodal vein inconspicuously marked.....**montium** Kirkaldy.

Genae entirely dark; costal area of tegmina with well-developed dark maculae, nodal vein enclosed in a broad dark patch..................**montivaga** Kirkaldy.

15(12). Corium adjacent to clavus continuously and conspicuously black or nearly black..........................16

Corium adjacent to clavus mostly pale..................19

16(15). Front of head extensively or almost entirely black; variable in dorsal color pattern but typically with vertex, pronotum and scutellum largely black, although usually with some yellow markings; clavi extensively black but with a variable yellow saddle mark; vertex more pointed than species of next couplet, distance from fore edge of eye to apex, as measured from side, about one-third as long as an eye...............**pluvialis** Kirkaldy.

Front of head yellowish, at most with only small dark areas (excepting in male of *sinuata* which is dark and which has almost entirely yellow clavi and otherwise is distinct); vertex arcuate, only about one-fourth or less as long on sides before eyes as length of an eye.....17

17(16). Face almost entirely black, grill evident; corial veins dark............................male **sinuata** Osborn.

Face pale, grill wanting; corial veins not dark...........18

18(17). Clavi almost entirely yellow, not dark except at most at base and apex; scutellum without three dark marks .... **giffardi** Kirkaldy.

Clavi each with a conspicuous, oblique, black band running from inner anterior corner to outer middle thus dividing each clavus into two yellow zones; scutellum with three dark maculae.......**giffardi interrupta** Osborn.

19(15). Apex of clavus with a long, slender, more or less line-like infuscation along inner margin only, dark color extending entirely across apex; apex of last abdominal ventrite of female pointed, usually not notched in middle; tegmina largely hyaline, veins all dark and prominent (Note: The male of this species may run to the next section which applies, however, to female *sinuata*).........................**silvicola** Kirkaldy.

Apex of clavus with a larger dark mark which extends entirely or almost entirely across apex, not thin and line-like; apex of last ventrite of female notched in middle; tegmina at least in part subopaque, specimens with color pattern similar to holotype have a large dark blotch at about basal third extending from costal margin nearly to clavus, but many examples lack this large macula or may have it greatly reduced, in which case corial veins are darker than surrounding membrane but not particularly prominent.....female **sinuata** Osborn.

Nesophrosyne affinis Osborn (fig. 15).
Nesophrosyne affinis Osborn, 1935:21, fig. 7.

Endemic. Hawaii (type locality: "Olaa, Crater Road, 27 miles, altitude 3,600 feet").

Holotype and allotype in the Bishop Museum.

This is a Hawaii representative of the *albicosta-lineata* group.

Nesophrosyne albicosta Osborn (fig. 15).
Nesophrosyne albicosta Osborn, 1935:19, fig. 5.

Endemic. Oahu (type locality: Manoa Cliff Trail).

Hostplant: *Kadua acuminata.*

Holotype in the Bishop Museum.

At least one of Osborn's paratypes is *N. gouldiae* instead of *albicosta*. This species is much like *lineata*, but its head is differently shaped and the color pattern of the tegmina is distinct.

Nesophrosyne angulifera Osborn (figs. 14, a; 15).
Nesophrosyne angulifera Osborn, 1935:22, fig. 8.

Endemic. Molokai, Maui (type locality: Olinda, 4,200 feet).

Hostplant: *Coprosma.*

Holotype and allotype in the Bishop Museum.

This species has a color pattern like that of *obliqua,* but the vertex is produced and more pointed and is subapically impressed.

Nesophrosyne bicolorata Osborn (fig. 15).
Nesophrosyne bicolorata Osborn, 1935:25, fig. 11.

Endemic. Oahu (type locality: Punaluu).

Hostplant: *Kadua.*

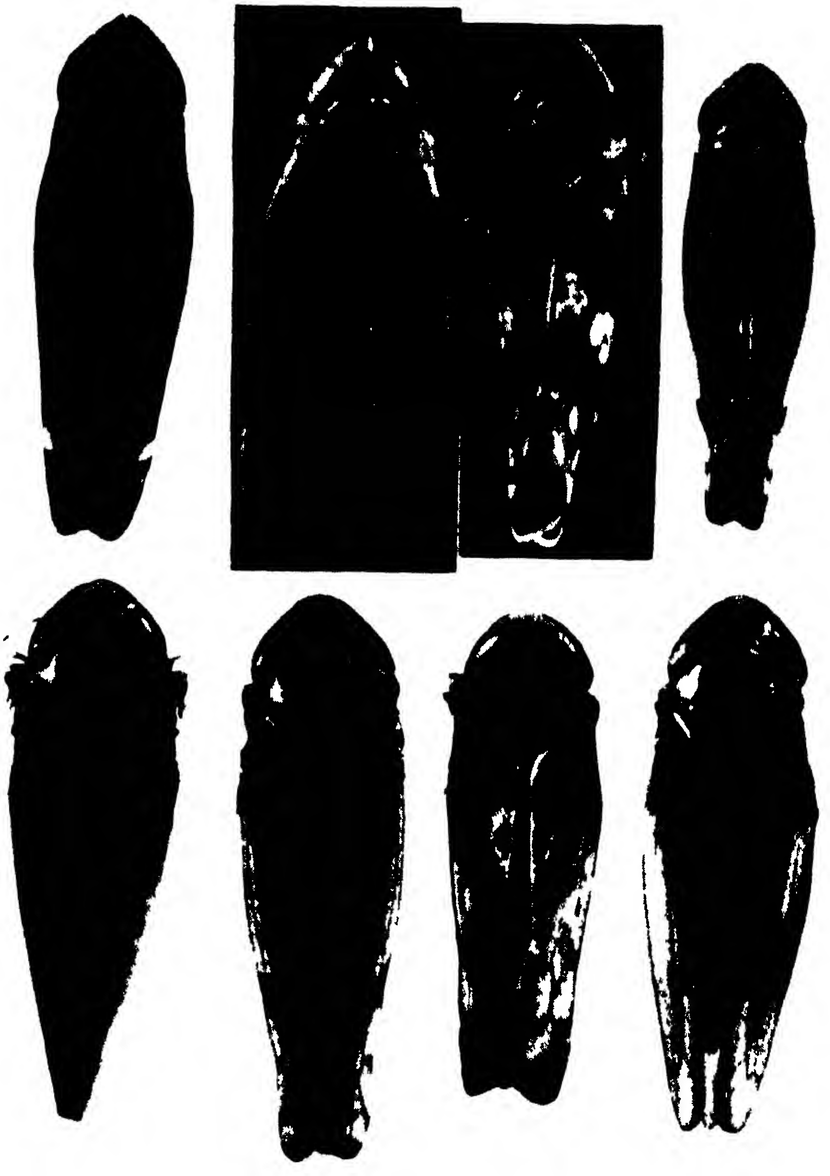

Figure 15—*Nesophrosyne* species. Top row, left to right: *N. affinis* Osborn, allotype; *N. albicosta* Osborn, paratype; *N. angulifera* Osborn, paratype; *N. bicolorata* Osborn, paratype. Bottom row, left to right. *N. bobeae* Kirkaldy; *N. cinerea* Osborn, holotype; *N. craterigena* Kirkaldy; *N. cuprescens* Osborn, holotype.

The holotype and allotype mounts, each containing two specimens on the same pin, are in the Bishop Museum. Some of the paratypes are different species from Osborn's holotype.

Nesophrosyne bobeae Kirkaldy (fig. 15).
Nesophrosyne bobeae Kirkaldy, 1910:564. Osborn, 1935:38.

Endemic. Oahu (type locality: Mount Tantalus, 1,800 feet).
Hostplant: *Bobea elatior.*
The type mount in Perkins' collection, now in the Bishop Museum, consists of four examples mounted together on an elongate card. Perkins notes in his letter: "We found no other specimens of this species" [in the Kirkaldy collection, that is]. Osborn notes that no type material was found in the British Museum. It is closely allied to the Lanai *oneanea.* Perhaps the two forms may prove not to be distinct full species.

Nesophrosyne caelicola Kirkaldy.
Nesophrosyne caelicola Kirkaldy, 1910:566. Osborn, 1935:39.

Endemic. Lanai (type locality: 3,000 feet).
Type in the British Museum, where it was examined by Osborn.
Osborn identified specimens from Oahu and Hawaii as this species, but as I am not sure that all of these specimens are the same as the Lanai type, I prefer to limit the species to the type locality pending further study.

Nesophrosyne cinerea Osborn (fig. 15).
Nesophrosyne cinerea Osborn, 1935:35, fig. 16.

Endemic. Maui (type locality: Olinda, 4,200 feet).
Hostplant: *Coprosma montana.*
Although not mentioned in the original description, this species is obviously related to *furculata.* However, it is closely similar to our cotype (?) of *oneanea* and may be only a teneral specimen of that species or a pale color form of it. More material must be seen to ascertain its status. The holotype is in the Bishop Museum.

Nesophrosyne craterigena Kirkaldy (fig. 15).
Nesophrosyne craterigena Kirkaldy, 1910:571. Osborn, 1935:37.

Endemic. Hawaii (type locality: Kona).
Osborn examined the male holotype in the British Museum. Perkins said in his letter that "The description of this and of *pele* was left incomplete (with blank

spaces in the proof). I attempted to fill in the gaps in *craterigena,* but could not do so in *pele.*" I am not sure that the material determined by Osborn as this species and used by me for the keys has been correctly determined.

Nesophrosyne cuprescens Osborn (fig. 15).
Nesophrosyne cuprescens Osborn, 1935:26, fig. 13.

Endemic. Oahu (type locality: "Palolo Hill").
Hostplant: *Metrosideros.*
The holotype is in the Bishop Museum.

Nesophrosyne ehu Kirkaldy.
Nesophrosyne ehu Kirkaldy, 1910:569. Osborn, 1935:31.

Endemic. Hawaii (type locality: Kilauea).
Although Perkins said in his letter that the type should be in the British Museum, Osborn stated that it could not be found in that collection. The specimen referred to by Osborn in his revision and there redescribed is in the Bishop Museum. It is the Hilo cotype collected by Swezey as mentioned by Kirkaldy. However, it bears the following label "? same sp. cotype. R.C.L.P.," indicating that Perkins was not sure that it represented the same species as Kirkaldy's type from Kilauea.

Nesophrosyne furculata Osborn (figs. 14, b; 16).
Nesophrosyne furculata Osborn, 1935:29, fig. 14.

Endemic. Lanai (type locality: 2,500–3,500 feet).
This species is an associate of *cinerea.* The holotype and allotype are in the Bishop Museum.

Nesophrosyne giffardi Kirkaldy (fig. 16).
Nesophrosyne giffardi Kirkaldy, 1910:563. Osborn, 1935:31.

Endemic. Oahu (?), Hawaii (type locality: Kailua).
Osborn examined the type in the British Museum. The large series he returned to Bishop Museum under this name contains several forms from several islands and requires careful revision.

Nesophrosyne giffardi interrupta Osborn (fig. 16).
Nesophrosyne giffardi variety *interrupta* Osborn, 1935:32.

Endemic. Hawaii (type locality: Kona, 4,000 feet).
Hostplant: *Myoporum.*

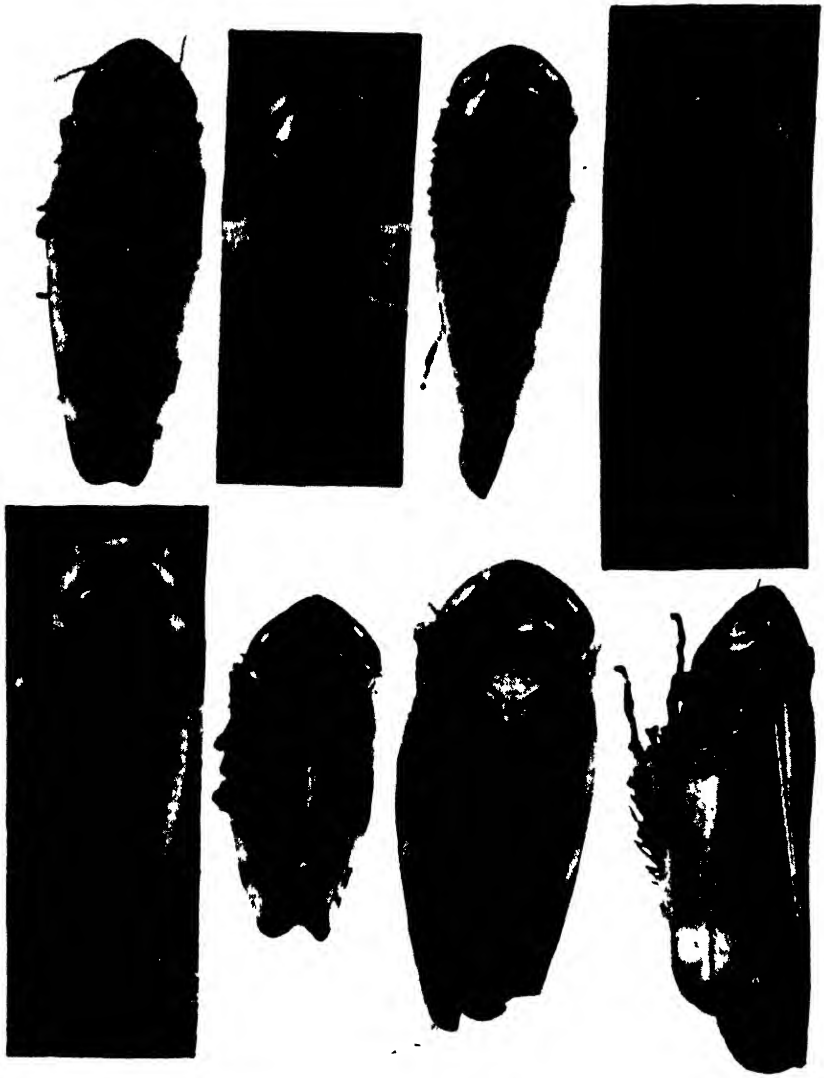

Figure 16—Species of *Nesophrosyne*. Top row, left to right: *N. furculata* Osborn, paratype; *N. giffardi* Kirkaldy; *N. giffardi interrupta* Osborn; *N. gouldiae* Kirkaldy, pale form. Bottom row, left to right: *N. gouldiae* Kirkaldy, dark form; *N. haleakala* Kirkaldy; *N. halemanu* Kirkaldy; *N. ignigena* Kirkaldy.

The holotype and allotype are in the Bishop Museum. I have seen examples of the typical form taken with this color variety from the same hostplant. Some examples of the typical form show a tendency toward assuming the tegminal color pattern of the variety.

Nesophrosyne gouldiae Kirkaldy (figs. 8, b; 16).
Nesophrosync gouldiae Kirkaldy, 1910:560. Osborn, 1935:28.

Endemic. Oahu (type series from Mount Tantalus, 1,400 feet, and Palolo, 1,400 feet).

Hostplant: *Cyrtandra cordifolia.* (The hostplant was erroneously given in *Fauna Hawaiiensis* as *Gouldia.* The error was corrected by Swezey in a footnote in Osborn, 1935:28).

The type mount is in the Bishop Museum and consists of two specimens, one of the pale immaculate forms (female) and one which has extensive dark coloring on the dorsum (male).

This species belongs to the *ponapona–pipturi* complex and has the pronotum wider than the head, but it may be distinguished because of the unusual shape of the head as seen from the side. The latter character is best appreciated by observation, and it is difficult to describe adequately.

Nesophrosyne haleakala Kirkaldy (fig. 16).
Nesophrosync haleakala Kirkaldy, 1910:567. Osborn, 1935:17.

Endemic. Maui (type locality: Haleakala, 9,000 feet).

Hostplant: *Coprosma* or *Vaccinium.*

The type was seen in the British Museum by Osborn. Perkins notes that it was labeled with the manuscript name *"nivata,"* not *halcakala,* by Kirkaldy.

Osborn identified specimens from Kauai (on *Campylotheca*) as this species, but I believe that they represent another species. I have seen another new species from Maui which belongs to this group of short species, and which has a more rounded vertex.

I have collected this species from the high slopes of Haleakala (8,500 feet) from a mixed growth of *Coprosma* and *Vaccinium.* The tendency toward brachyptery is particularly noteworthy.

Nesophrosyne halemanu Kirkaldy (fig. 16).
Nesophrosyne halemanu Kirkaldy, 1910:559. Osborn, 1935:16.

Endemic. Kauai (type locality: Halemanu, 4,000 feet).

Osborn examined the type at the British Museum.

Nesophrosyne ignigena Kirkaldy (fig. 16).
Nesophrosyne ignigena Kirkaldy, 1910:570. Osborn, 1935:37.

Endemic. Hawaii (type locality: Kilauea).
Hostplant: *Pittosporum longifolia.*
Perkins said in his letter that the type should be in the British Museum, and that "Giffard's specimen (only one) is not quite like the type." Osborn said, "I have not found any specimens to refer to this species and it seems probable that it should rank as a variety only, perhaps one of the many forms of *N. silvicola,* though smaller." However, there is a single example of this species in Perkins' collection at the Bishop Museum, and I have determined a good series of specimens, including nymphs, from the above mentioned hostplant, collected by Timberlake in Kau, Hawaii. The clavi are more opaque than the remainder of the tegmina and are more yellow in appearance.

Nesophrosyne imbricola Kirkaldy (fig. 17).
Nesophrosyne imbricola Kirkaldy, 1910:566. Osborn, 1935:46.

Endemic. Lanai (type locality: over 2,000 feet), Hawaii (?).
The type was examined by Osborn in the British Museum.

Nesophrosyne lineata Osborn (fig. 17).
Nesophrosyne lineata Osborn, 1935:20, fig. 6.

Endemic. Molokai, Lanai (type locality: 1,900 feet).
The holotype and allotype are in the Bishop Museum.
Osborn's description of the female genitalia does not agree with his figure. The "last" ventral segment of the female is longer than the preceding and is distinctly concave at the sides.
I have seen what appears to be an offshoot of this species from Oahu, but it has the wing venation of *Nesoreias.* The species, or a new ally of it, occurs also on Maui, but more material is required to ascertain the true status of the Maui form. It is closely allied to, but distinct from *albicosta* from Oahu.

Nesophrosyne mabae Osborn (fig. 17).
Nesophrosyne mabae Osborn, 1935:49, fig. 19.

Endemic. Hawaii (type locality: South Kona Road, 1,900 feet).
Hostplant: *Maba sandwicensis.*
The holotype and allotype are in the Bishop Museum.

Nesophrosyne maritima Kirkaldy (fig. 17).
Nesophrosyne maritima Kirkaldy, 1910:560. Osborn, 1935:31.

Figure 17—*Nesophrosyne* species Top row, left to right *N imbricola* Kirkaldy, *N. lineata* Osborn, *N mabae* Osborn, paratype, *N maritima* Kirkaldy Bottom row, left to right: *N. milu* Kirkaldy, *N myrsines* Kirkaldy, *N montium* Kirkaldy (compared with type) ; *N. montivaga* Kirkaldy, cotype

Endemic. Oahu (type locality: Waianae Coast).
Hostplant: *Dodonaea viscosa.*
The type was examined at the British Museum by Osborn.

Nesophrosyne milu Kirkaldy (fig. 17).
Nesophrosyne milu Kirkaldy, 1910:565. Osborn, 1935:45.

Endemic. Lanai (type locality: 3,000 feet).
Osborn examined the type at the British Museum.

Nesophrosyne monticola Kirkaldy.
Nesophrosyne monticola Kirkaldy, 1910:562. Osborn, 1935:46.

Endemic. Oahu (type locality: Mount Kaala, over 2,000 feet).
Hostplant: *Perrottetia, Wikstroemia* (?).
The type should be in the British Museum, according to Perkins.

Nesophrosyne montium Kirkaldy (fig. 17).
Nesophrosyne montium Kirkaldy, 1910:569. Osborn, 1935:42.

Endemic. Hawaii (type locality: Mountain View).

There are in the Bishop Museum two specimens, a male and a female, mounted on the same pin, collected by Swezey at Mountain View, Hawaii, March 31, 1906, which are labeled "Type of *Nesophrosyne montium* Kirk" with a large red type label. These specimens are those mentioned as the type material by Kirkaldy in his original description. However, Perkins, in his letter, says that the type from Puna, Hawaii, is in the British Museum, and that "Swezey's specimens appeared to me to be doubtfully the same, according to my note." Osborn stated that "A specimen in the Natural History Museum, London, presumably the type, is smaller than those in hand." He redescribed the species from one of Swezey's Mountain View specimens which he considered to be a cotype. Kirkaldy does not mention any Puna specimens in his original description, and I would consider that only those specimens specifically mentioned by him in his original description could rightfully belong to his cotype series. I thus feel that the Bishop Museum specimens labeled "type" from Mountain View should be considered the true type rather than the specimen in the British Museum from Puna. See also the discussion under *ponapona.*

Nesophrosyne montivaga Kirkaldy (fig. 17).
Nesophrosyne montivaga Kirkaldy, 1910:569. Osborn, 1935:41.

Endemic. Hawaii (type locality: Kilauea).

Perkins says in his letter that the type should be in the British Museum, but Osborn states, "Type location not known but specimens probably from type material in HSPA collection." The Hamakua cotypes (three examples on one pin) and a specimen from Kilauea are in the Bishop Museum. The Kilauea example bears the data listed by Kirkaldy for the holotype, and although it bears no type label, it may be the holotype. Further checking at the British Museum is needed to settle the question.

Nesophrosyne myrsines Kirkaldy (fig. 17).

Nesophrosyne myrsines Kirkaldy, 1910:568.

Nesophrosyne arcadiicola Kirkaldy, 1910:571 (Hawaii, type locality: Hilo). Osborn, 1935:44. New synonym.

Endemic. Hawaii (type locality: Kilauea).

Hostplants: *Coprosma pubens, Myrsine, Sadleria* fern.

The holotypes of both *myrsines* and *arcadiicola* are in the Bishop Museum and are now before me. They represent the same species, and the above synonymy is necessary.

Kirkaldy (1910:568) described the beautiful yellow, black and crimson nymph. The specimen of the nymph described is mounted on the same card as his holotype.

Osborn (1935:40) described another species under this name, because he did not know *myrsines*, and he erroneously identified a series of specimens of another species as *myrsines*. He said, "No type specimen was found in Natural History Museum, London. Type probably lost as there is no specimen in the collection so labeled as to distinguish it." The holotype is preserved in good condition in the type collection of Bishop Museum and is from Perkins' collection. I have been unable to identify the species confused with *myrsines* by Osborn, and it appears to be new.

Although superficially different because of its dark color, this species has affinities with such species as *Nesoreias eburneola*. In fact, I have seen a specimen in which one wing is typical of *Nesophrosyne*, the other of *Nesoreias*.

Nesophrosyne nimbicola Kirkaldy (fig. 19).

Nesophrosyne nimbicola Kirkaldy, 1910:565. Osborn, 1935:44.

Endemic. Lanai (type locality: "over 2000–3000 ft.").

Hostplant: *Myrsine* (*Suttonia*) *lessertiana*.

The type is in the British Museum where it was examined by Osborn.

Nesophrosyne nimbigena Kirkaldy (fig. 19).

Nesophrosyne nimbigena Kirkaldy, 1910:567.

Endemic. Maui (type locality: Mount Haleakala, over 5,000 feet).

Perkins notes in his letter that the type should be in the British Museum, but it was not located there when Osborn studied the group. One of Perkins' specimens from Haleakala is in the Bishop Museum and bears the following label written by Perkins: "clearly—nimbigena." The specimens returned by Osborn identified and described as this species (1935:38) represent different species.

Nesophrosyne notatula Osborn (figs. 8, h; 19).
Nesophrosyne notatula Osborn, 1935:47, fig. 17.

Endemic. Oahu (type locality: Mount Kaala, 1,500–1,600 feet).
Hostplant: *Metrosideros.*
Holotype and allotype in the Bishop Museum.

Nesophrosyne nubigena Kirkaldy (fig. 18).
Nesophrosyne nubigena Kirkaldy, 1910:567.

Endemic. Lanai (type locality: 2,000 feet).

This species was overlooked by Osborn and not included in his 1935 revision. The unique holotype is in rather poor condition, as is indicated by our illustration made at the British Museum. I have not recognized any specimens of this species in the material I have seen.

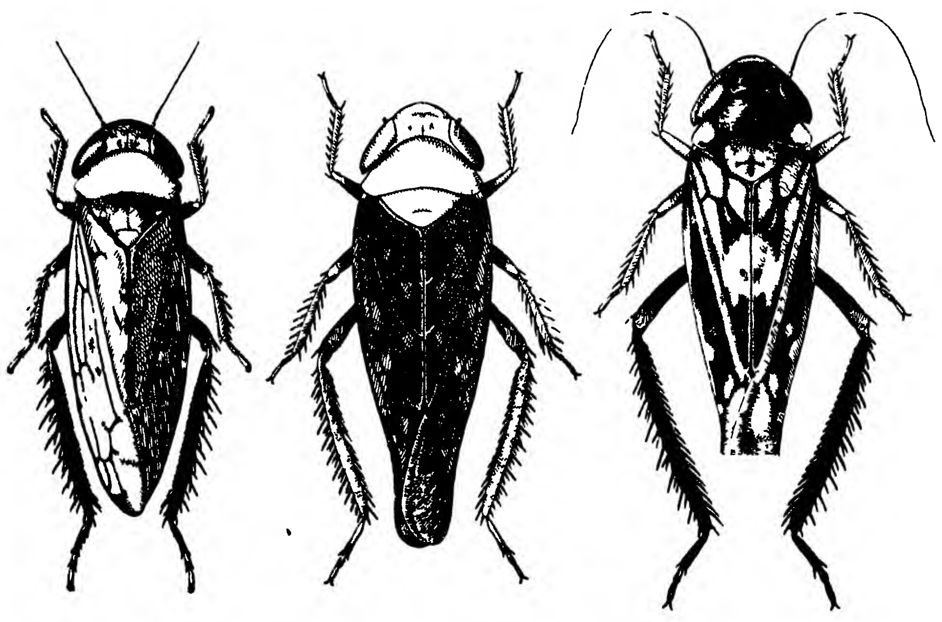

Figure 18—Holotypes of *Nesophrosyne*: *N. nubigena* Kirkaldy, left (type in poor condition); *N. opalescens* Kirkaldy, middle; *N. paludicola* Kirkaldy, right. (Drawn at the British Museum of Natural History by Smith.)

Nesophrosyne nuenue Kirkaldy (figs. 13, c; 19).
Nesophrosyne nuenue Kirkaldy, 1910:572. Osborn, 1935:32.

Endemic. Lanai, Hawaii (type locality: Kilauea).
Hostplant: *Dodonaea viscosa* variety *spathulata.*
Kirkaldy (1910:572) described the nymph.

Perkins said in his letter that the type "should have been amongst Kirkaldy's or Swezey's specimens," and I have located this material. The type mount now in Bishop Museum consists of two examples. Osborn said that no type material could be located in the British Museum, but he apparently did examine the holotype which was sent to him from Honolulu. Osborn determined a large series of Lanai specimens as this species, but he failed to list them in his text.

Nesophrosyne obliqua Osborn (fig. 19).
Nesophrosyne obliqua Osborn, 1935:23, fig. 9.

Endemic. Maui, Lanai (type locality: 2,300–2,400 feet).
Hostplants: *Coprosma montana, Sadleria* fern.
Holotype and allotype in the Bishop Museum.

In my opinion, the "last ventral segment" of the female is longer than is indicated by Osborn. The species is remarkably similar to *angulifera* from Molokai and Maui, but the vertex is shorter and less pointed and is not conspicuously subapically impressed as in that species.

Nesophrosyne oneanea Kirkaldy (fig. 19).
Nesophrosyne oneanea Kirkaldy, 1910:566. Osborn, 1935:35.

Endemic. Lanai (type locality: 3,000 feet).

The type was examined at the British Museum by Osborn. It is evidently a close ally of the Oahu *bobeae* and the Hawaii *silvicola* A cotype (?) from the *Fauna Hawaiiensis* collection in Bishop Museum does not agree with the example compared with the holotype by Osborn. See also the notes under *cinerea.*

Nesophrosyne opalescens Kirkaldy (fig. 18).
Nesophrosyne opalescens Kirkaldy, 1910:561. Osborn, 1935:28.

Endemic. Oahu (type locality: "Waianae Mts.").

Osborn (p. 28) says, "I have not found any type. Specimens which agree with the descripiton can be referred to *N. pipturi* by recognizing the opalescent character as variable." I have seen no specimens assigned to this species. A drawing of the type, which is in the British Museum, is included herewith.

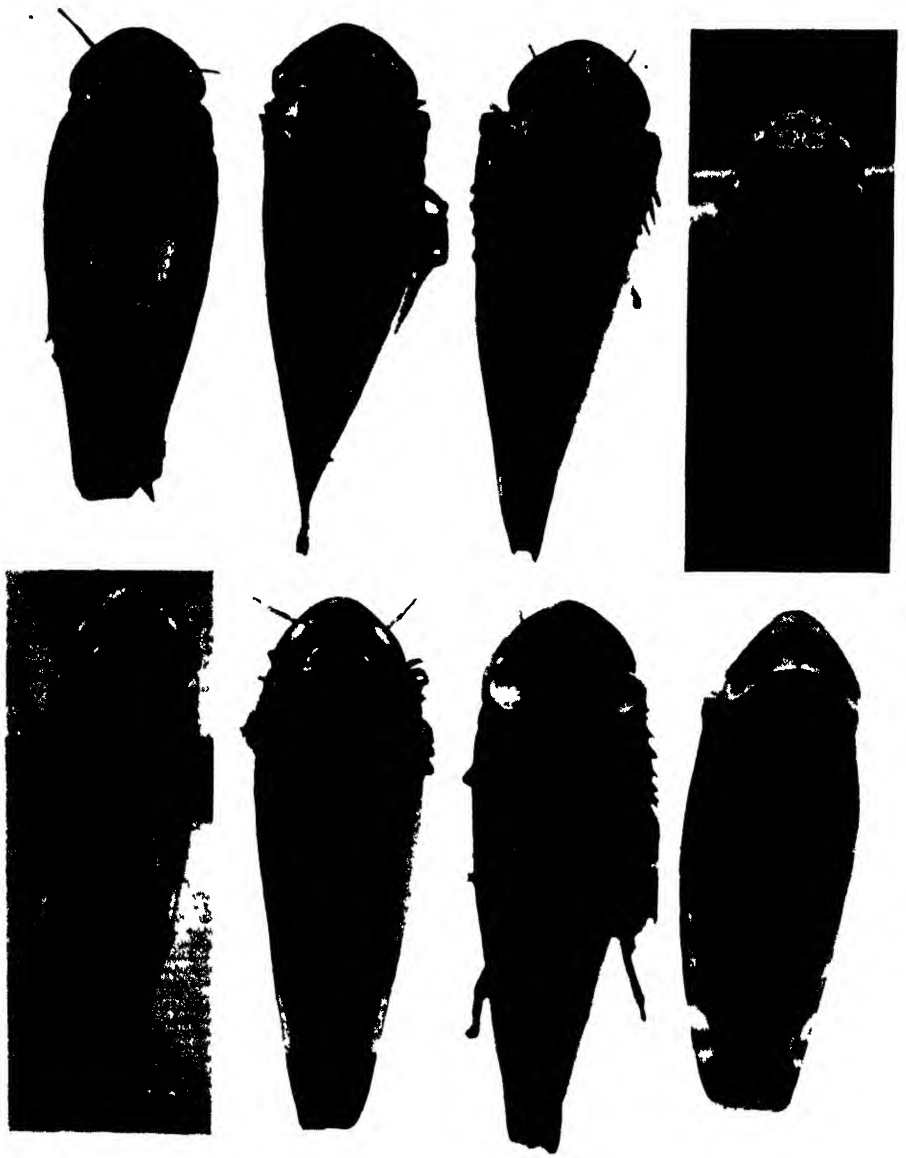

Figure 19—*Nesophrosyne* species. Top row, left to right: *N. nimbicola* Kirkaldy; *N. nimbigena* Kirkaldy; *N. notatula* Osborn, allotype; *N. nuenue* Kirkaldy. Bottom row, left to right: *N. obliqua* Osborn, paratype; *N. oneanea* Kirkaldy (compared with type by Osborn); *N. oreadis* Kirkaldy; *N. palolo* Osborn, allotype.

Nesophrosyne oreadis Kirkaldy (fig. 19).
Nesophrosyne oreadis Kirkaldy, 1910:569. Osborn, 1935:41.

Endemic. Oahu, Hawaii (type locality: Kilauea).
Hostplant: *Wikstroemia.*
Osborn stated, "Location of the type if existing is not known." Perkins said in his letter, "I could find no trace of the type of this sp. but may have overlooked it. It should bear beneath the card (or on a label, if pinned) the number 656." I have found Kirkaldy's original type in the Bishop Museum. It bears the number 656, and is labeled with Kirkaldy's manuscript name *volcanicola.* It is not surprising that it has been lost for so many years. I have labeled it as the holotype and placed it in the type collection.

It has not been recorded from Oahu before, but specimens agreeing with the type have been seen from Konahuanui and Kaumuohona. Osborn determined some specimens from "Kilauea, 29 miles," Hawaii, as *arcadiicola.*

Nesophrosyne palolo Osborn (fig. 19).
Nesophrosyne palolo Osborn, 1935:24, fig. 10.

Endemic. Oahu (type locality: Palolo Valley).
The holotype and allotype are in the Bishop Museum.

Nesophrosyne paludicola Kirkaldy (fig. 18).
Nesophrosyne paludicola Kirkaldy, 1910:564. Osborn, 1935:44.

Endemic. Molokai (type locality: 4,000 feet).
Kirkaldy had only a single example of this species, and I have not recognized it among the material studied. Osborn failed to find the type at the British Museum, but I include a drawing made from the type which has since been located in that institution.

Nesophrosyne palustris Kirkaldy.
Nesophrosyne palustris Kirkaldy, 1910:564. Osborn, 1935:39.

Endemic. Molokai (type locality: Kahanui).
The unique holotype of this species (now in Bishop Museum) is a teneral individual. I have seen one other example, identified by Osborn, which is closely similar to the type with which I have compared it. I am not sure that this species is really specifically distinct from *ulaula,* although the bright red coloring of its clavus, head and thorax is conspicuous. This red coloration is variable, however, and it is more distinct and extensive on the holotype than on the other example at hand.

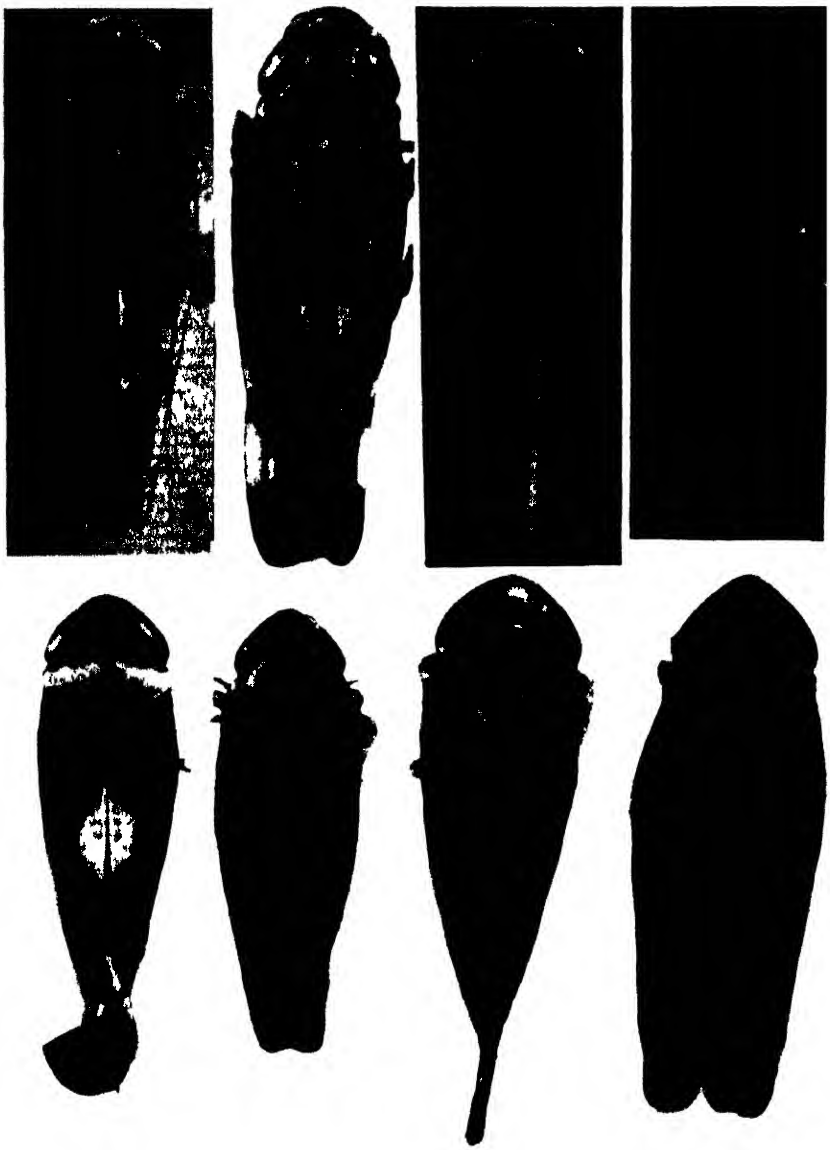

Figure 20—*Nesophrosyne* species. Top row, left to right: *N. pele* Kirkaldy; *N. peleae* Osborn, paratype; *N. perkinsi* (Kirkaldy); *N. piptun* Kirkaldy. Bottom row, left to right: *N. pluvialis* Kirkaldy; *N. ponapona* Kirkaldy; *N. procellaris* Kirkaldy (compared with type by Osborn); *N. signatula* Osborn, allotype.

Nesophrosyne pele Kirkaldy (fig. 20).
Nesophrosyne pele Kirkaldy, 1910:570. Osborn, 1935:47.

Endemic. Hawaii (type locality: Kilauea).
The type was examined in the British Museum by Osborn. Perkins says in his letter that the type is from Kilauea, 1895, and that "Kirkaldy's label in pencil was nearly illegible." (See the note under *craterigena,* also.)

Nesophrosyne peleae Osborn (figs. 14, c; 20).
Nesophrosyne peleae Osborn, 1935:25, fig. 12.

Endemic. Oahu (type locality: Mount Kaala).
Hostplant: *Pelea.*
The holotype and allotype are in the Bishop Museum.
Osborn makes no mention in his text that he designated a series of specimens from Kilauea, Hawaii, as paratypes, but such material is in Bishop Museum. These Kilauea examples are differently colored and are apparently a different form. His figures 12, *a, b,* are of the female holotype, which, it appears, is somewhat teneral and does not have the color pattern as well defined as do more mature specimens.

Nesophrosyne perkinsi (Kirkaldy) (figs. 8, i, k; 9; 13, a, b; 20).
Eutettix perkinsi Kirkaldy, 1904:178.
Nesophrosyne perkinsi (Kirkaldy) Kirkaldy, 1907a:160; 1908:208, fig. 3. Osborn, 1935:30. Genotype.

Endemic. Oahu (type locality: Diamond Head ["Leahi"], Honolulu).
Hostplant: *Sida cordifolia* ("ilima").
Kirkaldy described the nymph. Perkins noted in his letter that the type should be in the British Museum.

Nesophrosyne pipturi Kirkaldy (figs. 8, a; 20).
Nesophrosyne pipturi Kirkaldy, 1910:560. Osborn, 1935:27.

Endemic. Oahu (type locality: Mount Tantalus, 1,300 feet).
Hostplant: *Pipturus,* abundant at times.
According to Perkins' letter the type should be in the British Museum.
See my remarks under *ponapona,* below.

Nesophrosyne pluvialis Kirkaldy (fig. 20).
Nesophrosyne pluvialis Kirkaldy, 1910:568. Osborn, 1935:43 (applies to this species ?).

Endemic. Hawaii (type locality: Olaa).

Hostplants: *Acacia koa, Broussaisia, Coprosma.*

The type was examined in the British Museum by Osborn.

Osborn's extensive series under this name is composed of several species from several islands. I have listed only the type locality.

Nesophrosyne ponapona Kirkaldy (*figs. 8, j; 20*).

Nesophrosyne ponapona Kirkaldy, *1910:561*. Osborn, *1935:30*.

Endemic. Oahu (type locality: Mount Tantalus).

Hostplant: *Pipturus.*

Osborn examined the type in the British Museum.

I have compared the type of *N. montium,* which is in Bishop Museum, with cotypes of *ponapona* and a large series of specimens determined by Osborn which apparently include both forms. Kirkaldy said that *montium* differs from *ponapona* by "the clypeus and lora being always dark piceous, except a short ferruginous line on the clypeus, and by the dark suffused terminal subapicals" (1910: 569), whereas *ponapona* has the "clypeus and lora apically blackish brown." I cannot separate these forms satisfactorily by these characters, for there appears to be almost every gradation in color of the face from immaculate and pale to almost entirely black. The species appears to be highly variable. However, I believe that it would be unwise to place *montium* with it without first making a careful study of the entire series. There may be more than two species involved, or there may be a series of color forms On a single card of Kirkaldy's cotypes of *ponapona* (from Mount Tantalus, Oahu, in Perkins' collection), containing six specimens, three examples have the face immaculate, and three have dark marks at the apices of the clypeus and lora. The male and female types of *montium* also have more extensive dark coloring on the tegmina as outlined in the key. This latter difference is the more conspicuous one.

There is a discrepancy between Kirkaldy's description of *ponapona* and the series of his which I have examined. He says that there are "two nodal veins, one from the middle, one from the base of the exterior subapical cell, suffused." In none of the cotype specimens examined is there more than one nodal from the exterior subapical cell. The type needs reexamination.

Osborn's *touchardii* belongs in this group and is not always easily separable from *ponapona*. However, I have found *ponapona* and *pipturi* to be more closely allied and difficult to separate. The ventral surface of *pipturi* appears to be quite stable in its entirely pale color, whereas *ponapona* is usually dark, but pale specimens do occur. The hind wings of *ponapona* appear usually to be more transparent with dark veins, whereas they may be more opaque milky-white with pale veins in *pipturi*.

This is a complex, involved and most confusing group, and a proper understanding of it can only be had by more detailed study than can be afforded here.

Nesophrosyne procellaris Kirkaldy (fig. 20).
Nesophrosyne procellaris Kirkaldy, 1910:565. Osborn, 1935:33.

Endemic. Molokai (type locality: Kalae).
Osborn examined the type in the British Museum.

Nesophrosyne signatula Osborn (figs. 8, g; 20).
Nesophrosyne signatula Osborn, 1935:48, fig. 18.

Endemic. Oahu (type locality: Mount Kaala, 2,000 feet).
Hostplant: *Alyxia olivaeformis.*
The holotype and allotype are in the Bishop Museum.

Nesophrosyne silvicola Kirkaldy (fig. 21).
Nesophrosyne silvicola Kirkaldy, 1910:570. Osborn, 1935:36.

Endemic. Hawaii (type locality: Kilauea), Lanai.
Hostplants: *Metrosideros, Straussia hawaiiensis.*
Osborn examined the type in the British Museum collection and noted that it "has no locality record except 'Sandwich Ids. no. 656'." The number 656 is Perkins' field number meaning "Kilauea, Hawaii, August, 1896." An example with similar data is in the Bishop Museum. Kirkaldy noted that he selected a Kilauea specimen as the type. Perkins says in his letter, "The specimens variable, and I could see none from Kona nor from Lanai; there were two of Swezey's from Hamakua, according to my note." Osborn determined a series of specimens from Oahu as this species, but I have not accepted his determination.

Nesophrosyne silvigena Kirkaldy (fig. 22).
Nesophrosyne silvigena Kirkaldy, 1910:559. Osborn, 1935:37 (applicable to this species ?).

Endemic. Kauai (type locality: Kaholuamano).
Perkins stated in his letter that the type should be in the British Museum, but Osborn said that he could not find it there. However, the type is there, and a drawing of it is presented herein. I do not know the species. A note sent in by Perkins stated that "This has pronotum nearly all whitish, as well as a roundish spot near the middle of the tegminal suture."

The series of eight specimens labeled as this species and returned to the Bishop Museum after study by Osborn includes possibly five species, probably none of which is this species, from four different islands.

Figure 21—*Nesophrosyne* species. Top row, left to right: *N. silvicola* Kirkaldy, cotype (compare bottom figure); *N. sinuata* Osborn; *N. touchardii* Osborn, paratype; *N. ulaula* Kirkaldy. Bottom: lateral view of specimen at left top, *N. silvicola* Kirkaldy.

Nesophrosyne sinuata Osborn (fig. 21).
Nesophrosyne sinuata Osborn, 1935:34, fig. 15.

Endemic. Hawaii (type locality: Olaa, 29 miles, 3,800 feet).
Hostplant: *Metrosideros.*
The holotype is in the Bishop Museum.
This species resembles a pale form of what Osborn identified as *pluvialis.* In fact, examples which agree with his holotype were placed by him under *pluvialis,* and others from the same lot were placed with *silvicola.* I have seen only one male in a series of 15 or more examples.

Nesophrosyne touchardii Osborn (fig. 21).
Nesophrosyne touchardii Osborn, 1935:18, fig. 4.

Endemic. Oahu (type locality: Manoa), Hawaii (?).
Hostplant: *Touchardia.*
The type mount is in the Bishop Museum and consists of three examples on the same pin.
Osborn stated in the original description that the tegmina had "a fuscous patch at nodus and apex," but there is also a dark patch basad of the nodus. His male type has terminal appendages on the genital valves, but these are not indicated in his drawing. Osborn's type series appears to me to include more than one form. The paratypes from Hawaii may be distinct and are more like the Hawaii *montium* than typical *touchardii* from Oahu.

Nesophrosyne ulaula Kirkaldy (fig. 21).
Nesophrosyne ulaula Kirkaldy, 1910:563. Osborn, 1935:33.

Endemic. Oahu (type locality: "Honolulu Mts.," probably Mount Tantalus), Maui, Hawaii.
Hostplant: *Myrsine* (*Suttonia*) *lessertiana.*
Osborn examined the type at the British Museum. W. E. China has informed me that the holotype is damaged and lacks tegmina. It bears Perkins' collecting number 888 and was taken in July, 1900.
This species is closely allied to, if truly specifically distinct from, *palustris.* Kirkaldy said that he had only two females. A female specimen labeled by him as *"Nephotettix ula"* in the Bishop Museum appears to be a cotype. However, it bears Perkins' number 601 which refers to "Haleakala, Maui, 4,800+ ft. V '96," but Kirkaldy did not list Maui as a locality.

Nesophrosyne ulaula nigrolineata Kirkaldy.
Nesophrosyne ulaula variety *nigrolineata* Kirkaldy, 1910:563.

Endemic. Oahu (type locality: Moanalua, 2,000 feet; erroneously cited as "Maunaloa" by Kirkaldy).

The original specimen of this form is in the Bishop Museum and is labeled as "*Nesophryne ula* Kirk. Cotype." Beneath that label is one written in indelible pencil (by Osborn ?) which reads, "This specimen is described as *N. ulaula* var. *nigrolineata.*" It was the only specimen Kirkaldy had of this form, and it is thus the holotype of *nigrolineata.* I have so labeled it and placed it in the type collection at the Bishop Museum. The collecting data labels read "Maunaloa 2000 ft. Oahu" and "W. M. Giffard Coll. 31, XII, '05," as noted by Kirkaldy in his original description. This variety was overlooked by Osborn in his 1935 report. Perkins' letter noted that the type was in the Giffard collection, where I found it. It is doubtful that this is a good "variety."

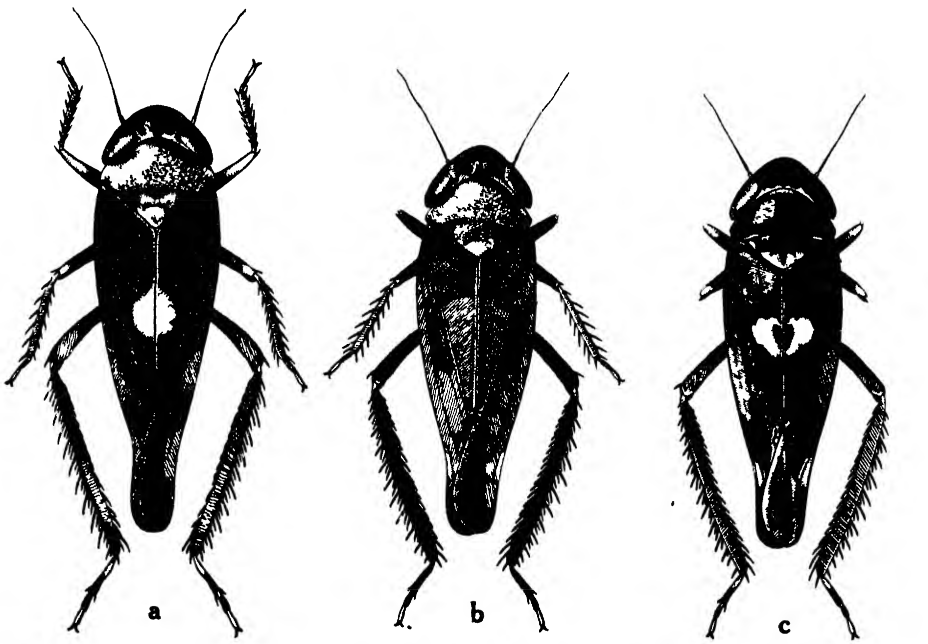

Figure 22—Holotypes of some *Nesophrosyne*: **a,** *N silvigena* Kirkaldy, **b,** *N umbricola* Kirkaldy; **c,** *N umbrigena* Kirkaldy (Drawn at the British Museum of Natural History by Smith)

Nesophrosyne umbratilis Kirkaldy.

Nesophrosyne umbratilis Kirkaldy, 1910:588. Osborn, 1935:17.

Endemic. Kauai (type locality: Kalihiwai, 400 feet).

Hostplant: *Microlepia strigosa* (?).

The holotype is in the Bishop Museum.

Osborn identified specimens from Hawaii as this species, but I believe them to be distinct from *umbratilis.*

Nesophrosyne umbricola Kirkaldy (fig. 22).

Nesophrosyne umbricola Kirkaldy, 1910:565. Osborn, 1935:45.

Endemic. Lanai (type locality: 2,000 feet).

Osborn says, "I have not found any specimens that could be separated from *N. nimbicola* that would seem to fit this description and I have not seen any type." I do not know it, but a drawing of the type in the British Museum has been made for this text.

Nesophrosyne umbrigena Kirkaldy (fig. 22).

Nesophrosyne umbrigena Kirkaldy, 1910:571. Osborn, 1935:40.

Endemic. Hawaii (type locality: Kilauea).

I have not recognized this species in the material I have seen, but a drawing of the type is included here. The type is in the British Museum, in spite of the fact that Osborn stated that he could not locate it there.

Subgenus **Nesoreias** Kirkaldy, 1910:558

Kirkaldy separated *N. insularis* and *N. oceanides* from the remainder of the *Nesophrosyne* known to him and established the subgenus *Nesoreias* for them because they have lost the outer anteapical cell from each tegmen. This is, in my opinion, not a natural, monophyletic subgenus, but it is a group of species descendant from more than one stock, some of which have lost their outer anteapical cells independently. It is retained here because the grouping is of aid in the identification of several species of a taxonomically difficult assemblage.

There is considerable variation in the size of the outer anteapical cell in the various species of *Nesophrosyne*. In some of them it is large and in others very small. In a male specimen, determined by Osborn as *Nesophrosyne craterigena*, the outer anteapical cell is present in the left wing, but it is absent in the right. Thus, the right side is *Nesophrosyne*, the left side *Nesoreias!* I have seen other specimens of other species with a similar arrangement. Other species have the outer anteapical cell much reduced. Kirkaldy (1910:572) records an individual of *Nesophrosyne nuenue* in which upon "one tegmen there is only one subapical, the exterior, both discoidals being undivided." In specimens of *Nesophrosyne furculata* the outer anteapical cell may be stylate at each end, or the posterior end may be joined to the apical cell directly and lack a single connecting vein, or one wing may be one way and the other wing the other. Further observations of the venation would reveal, I am sure, other "abnormalities." Most specimens examined have only three apical cells, but some have four.

Key to the Species of Nesoreias

1. Clavi almost entirely yellow, at most dark only at outer base and apex, but without a common saddle mark well isolated from base and apex 2
   Clavi with a distinct, common saddle mark well isolated from base 3

2(1). Tegmina broadly black or dark next to clavus; face pale .... **oceanides** Kirkaldy.
   Tegmina without such a dark band, apical cells dark, but elsewhere largely pale with veins partly or mostly dark and conspicuous; face with extensive dark coloring .... **insularis** Kirkaldy.

3(1). Clavus with inner margin dark along saddle mark so as to isolate the latter from claval margin which thus may be in form of a yellow comma, tegmen elsewhere mostly dark but with conspicuous white or subhyaline spots or areas, especially laterad where costal area may be largely pale .... **comma** Osborn.
   Not so colored, saddle mark not isolated from inner claval margin by any dark coloring 4

4(3). Saddle mark broad, extending to claval suture, at most dark at base and apex; tegminal veins usually orange or conspicuously red; more or less orange or brownish-orange species 5
   Saddle mark not extending to claval suture, mostly or entirely bordered with black; tegminal veins yellowish or dark, or if saddle mark does reach claval suture, then head is as broad or slightly broader than pronotum 6

5(4). Saddle mark collectively subovate; veins of tegmina almost entirely blood-red; "last" ventral segment of female abdomen notched in middle .... **sanguinea** Osborn.
   Saddle mark collectively elongate-subtriangular, tegminal veins mostly orange or yellowish; "last" ventrite of female not notched at middle .... **eburneola** Osborn.

6(4). Pronotum slightly but distinctly broader than head across eyes; face extensively dark .... **marginalis** Osborn.
   Head fully as broad or slightly broader across eyes than pronotum; face pale .... **koleae** (Kirkaldy).

Nesophrosyne (Nesoreias) comma Osborn (fig. 23).
Nesophrosyne (*Nesoreias*) *comma* Osborn, 1935:52, fig. 21.

Endemic. Hawaii (type locality: Kilauea).
The holotype is in the Bishop Museum.

Nesophrosyne (Nesoreias) eburneola Osborn (fig. 23).
Nesophrosyne (*Nesoreias*) *eburneola* Osborn, 1935:54, fig. 23.

Endemic. Hawaii (type locality: Glenwood, Olaa, 2,300 feet).

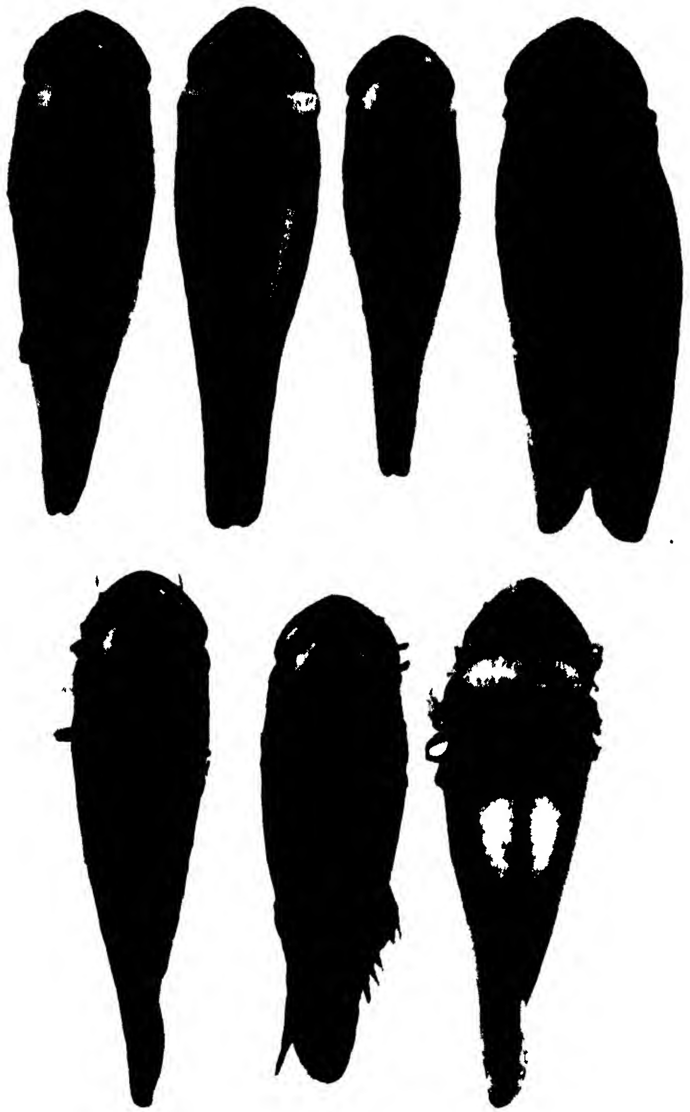

Figure 23—The species of *Nesoreias*. Top row, left to right: *N. comma* Osborn, allotype; *N. eburneola* Osborn, paratype; *N. insularis* Kirkaldy, cotype; *N. koleae* (Kirkaldy). Bottom row, left to right: *N. marginalis* Osborn; *N. oceanides* Kirkaldy; *N. sanguinea* Osborn, holotype.

Hostplants: *Antidesma platyphyllum, Myoporum sandwicense, Straussia hillebrandii.*

The holotype is in the Bishop Museum.

Nesophrosyne (Nesoreias) insularis Kirkaldy (figs. 9, 23).

Nesophrosyne (*Nesoreias*) *insularis* Kirkaldy, 1910:573. Osborn, 1935:51. Type of subgenus *Nesoreias.*

Endemic. Hawaii (type locality: Kilauea).

Hostplant: *Straussia hillebrandii.*

According to Perkins' letter, the type should be in the British Museum, but Osborn does not mention having seen it among the British Museum material. The cotypes from Hamakua are in the Bishop Museum.

Nesophrosyne (Nesoreias) koleae (Kirkaldy), new combination (fig. 23).

Nesophrosyne koleae Kirkaldy, 1910:562. Osborn, 1935:42.

Endemic. Oahu (type locality: Mount Tantalus, 1,300 feet).

Hostplants: *Eugenia sandwicensis* ("ohia ha"), *Myrsine lessertiana, Straussia.*

Osborn noted that no type material was seen by him at the British Museum. Perkins stated in his letter that the type was in the Giffard collection. I have found one of Kirkaldy's cotypes in the Giffard collection at the Bishop Museum and have designated this specimen as the holotype (Mount Tantalus, 1,300 feet, April 9, 1905, W. M. Giffard, collector). This example does not agree with every statement made in Kirkaldy's description, but other specimens of the series before me fill in the gaps.

Considerable confusion exists in regard to this species. Osborn's series determined as this species was mixed, and the specimens from Hawaii and Kauai as well as the example from Wahiawa, Oahu, belong to different species. Neither Kirkaldy nor Osborn noted that the outer anteapical cell was lacking and that the species belonged in *Nesoreias* instead of *Nesophrosyne.* There are six examples before me, and all of them have typical *Nesoreias* tegmina, and the species cannot remain in *Nesophrosyne* if *Nesoreias* is to be maintained.

Nesophrosyne (Nesoreias) marginalis Osborn (fig. 23).

Nesophrosyne (*Nesoreias*) *marginalis* Osborn, 1935:51, fig. 20.

Endemic. Hawaii (type locality: Kilauea, dry forest, 4,000 feet).

The holotype is in the Bishop Museum.

Nesophrosyne (Nesoreias) oceanides Kirkaldy (fig. 23).

Nesophrosyne (*Nesoreias*) *oceanides* Kirkaldy, 1910:573. Osborn, 1935:50.

Endemic. Hawaii (type locality: Olaa, 18 miles).

Hostplant: *Straussia hawaiiensis.*

The holotype is now in the Bishop Museum and the type nymph is mounted on the same card. Kirkaldy described the pretty nymph (1910:573).

Nesophrosyne (Nesoreias) sanguinea Osborn (fig. 23).

Nesophrosyne (Nesoreias) sanguinea Osborn, 1935:53, fig. 22.

Endemic. Lanai (type locality).

The holotype is in the Bishop Museum.

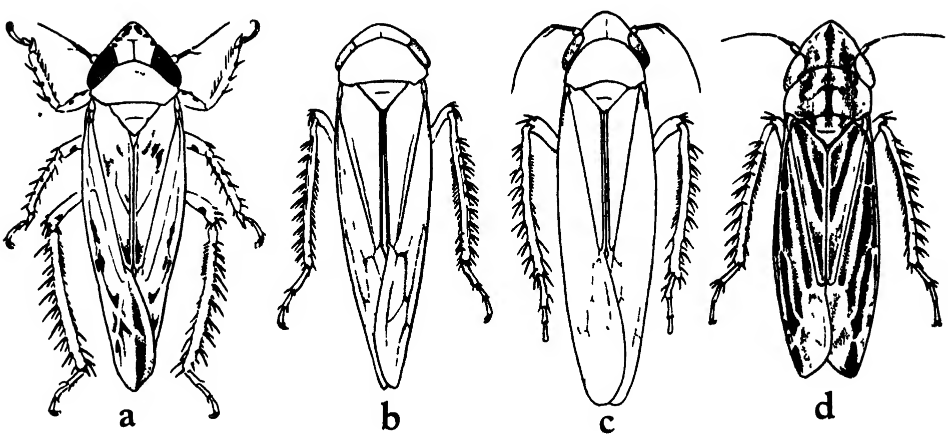

Figure 24—Some cicadellids. **a,** *Deltocephalus hospes* Kirkaldy; **b,** *Balclutha hospes* (Kirkaldy); **c,** *Balclutha timberlakei* (Osborn); **d,** *Nesolina lineata* Osborn. (Abernathy drawings.)

Genus **DELTOCEPHALUS** Burmeister, 1838

This is a widespread genus whose single immigrant representative in our fauna somewhat resembles certain of our pointed-headed *Nesophrosyne* and *Kirkaldiella.* Its non-stylate, outer anteapical cell will readily distinguish it from *Nesophrosyne,* and its more strongly produced, sharply pointed head will separate it from *Kirkaldiella,* although the differences between it and the latter genus are rather difficult to express in writing.

A single nymph examined has conspicuous, erect bristles on the entire dorsum including the wing pads.

Deltocephalus hospes Kirkaldy (figs. 24, a; 25, a–e).

Deltocephalus hospes Kirkaldy, 1904:177.

Phrynomorphus (*Conosanus*) *hospes* (Kirkaldy) Kirkaldy, 1907:60, pl. 1, figs. 13–17.

Conosanus hospes (Kirkaldy) Kirkaldy, 1907a:160.

Stirellus hospes (Kirkaldy) Osborn, 1935:55.

Kauai, Oahu (type locality: Honolulu, at light), Molokai, Hawaii.

Immigrant. Described from specimens taken in Honolulu, March, 1904, but now known to be a widespread species at least in eastern Australia and in the Marianas and Fiji.

Hostplants: *Cynodon dactylon* (Bermuda grass), *Digitaria henryi*.

The last nymphal instar has been described and figured by Kirkaldy (1907:60, pl. 1, fig. 13). The eggs are inserted in the leaves of the hostplant. The long- and short-winged adults, together with a wing of each, are also figured by Kirkaldy (1907: pl. 1, figs. 14–17).

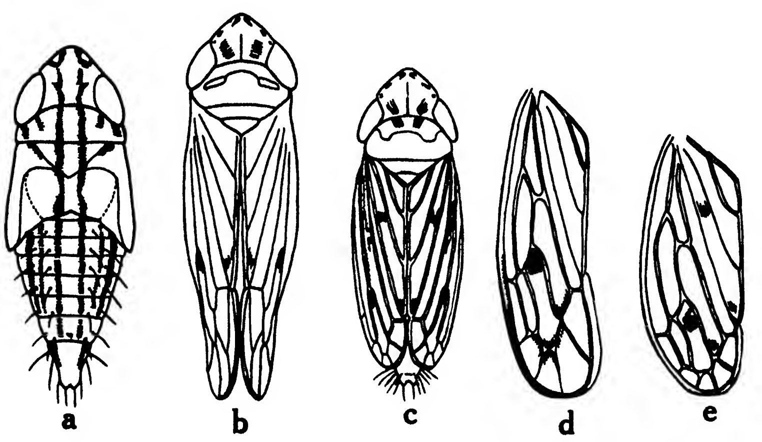

Figure 25—*Deltocephalus hospes* Kirkaldy: **a**, nymph; **b**, long-winged adult; **c**, brachypterous adult; **d**, tegmen of macropterous form; **e**, tegmen of brachypterous form. (Redrawn from Kirkaldy, 1907.)

The adult tegmina are typically hyaline or subhyaline with a yellowish or milky tinge, the middle anteapical cell has a dark spot at the base, there is a scattering of dark color on the membrane along some of the veins, and the outer and next to outer apical cells are usually at least partly infuscated. The vertex is conspicuously pointed. The adults have been collected at lights.

I have seen the species swarming by thousands on lawns at Punaluu, Oahu, but because of their habits and quick movements they might easily go unnoticed.

The type from Perkins' collection is now in the Bishop Museum.

Genus OPSIUS Fieber, 1866

A single immigrant species represents this genus in our fauna. The following combination of characters will serve to distinguish *Opsius* from its associates now known to occur in our Territory: vertex short, broadly rounded and broad (about three times as broad as long), tegmina with three anteapical cells, the outer one of which is not stylate at the apex. The nymphs do not have long, erect dorsal bristles.

Figure 26—*Opsius stactogalus* (Amyot).

Opsius stactogalus (Amyot) (fig. 26).

"Stactogale" stactogala Amyot, 1847:217.

Opsius stactogalus (Amyot) Fieber, Verh. zool.-bot. Ges. Wien 16:505, 1866. (Not seen.)

See Osborn, 1935:56, for synonymy.

The tamarix jassid.

Kauai, Oahu, Molokai, Lanai.

Immigrant. A widespread European species; common in North America. First found in Hawaii by H. L. Lyon at Honolulu in 1928 injuring *Tamarix aphylla.*

Hostplants: *Tamarix aphylla, Tamarix aestivalis, Tamarix indica, Tamarix africana.*

Parasite: *Polynema saga* (Girault) (Hymenoptera: Mymaridae), in the eggs.

"The eggs are laid singly just under the epidermis of the woody growth, usually transversely with reference to the axis of the branch." (Van Zwaluwenburg, *Proc. Hawaiian Ent. Soc.* 7(2):224, 1929, under the name *Euscelis stactogalus.*)

This species retains its green coloring after death and can almost be distinguished from our other euscelids because of its color alone. The tegmina each have several white spots and the apices are tinged with yellowish or brown.

Genus **BALCLUTHA** Kirkaldy, 1900

Gnathodus Fieber, 1806, preoccupied.
Nesosteles Kirkaldy, 1906:343.

This is a widespread genus containing a number of Pacific species from Indonesia to the Marquesas and Hawaii.

The head is slightly to distinctly broader than the pronotum in most species, but at least in one (*kilaueae*), the pronotum is broader than the head. The tegmina have an obsolescent vein which arises from the outer sector toward the base and rejoins the sector shortly beyond the fork as shown in the illustration. This vein is often almost impossible to detect, and, it must be admitted, one sometimes needs some imagination to distinguish it. In some examples, however, it is fairly obvious, but perhaps it is wanting in others. A close study of the wing under various light conditions and a comparison with the illustrations will be necessary. (Traces of this vein are difficult to see even when best developed; look for a slight inward angulation of the sector basad of the fork at which place the vein arises, and the sector is usually very slightly angulate beyond the fork where the obsolescent vein rejoins the sector.) However, the species form a rather distinct group in our fauna, and as a genus they should not be difficult to place on their general facies alone.

The genus is a taxonomically difficult assemblage of small, slender leafhoppers. They are poorly known. They occur throughout the main islands; there are more Hawaiian species than have been described, and a critical review of the specimens assembled in collections is needed.

Perkins, in a letter to Swezey dated June 15, 1945, includes the following notes: "The species of this which was common at Honolulu was found containing gonatopine larvae by Kirkaldy himself. He found several thus parasitized but killed them without noticing this till they were dead. No doubt living pupae of gonatopines in their cocoons on grass stems were occasionally brought to Honolulu when hay was imported. No gonatopines on Jassids were ever liberated by Koebele or myself in the islands."

Kirkaldy (1910:574) and Osborn (1935:57) each gave a key to the species. I have drawn up a new key with the aid of the types of each species, but a more careful survey of the group should reveal other, and perhaps better, characters to use for the separation of the species.

The nymphs have no erect bristles on the dorsum. The adults of at least some of the species have been collected in numbers at lights.

Key to the Hawaiian Balclutha

1. Pronotum broader than head (9:8); vertex along median line half as long as distance between eyes; length 4 mm. .... **kilaueae** (Kirkaldy).
   Head broader than pronotum.......................... 2

2(1). Vertex along median line hardly longer than one-fourth distance between eyes, or shorter, and subequal in length along median line and at inner edges of eyes or very slightly shorter; length 3.5–4.0 mm.....**hospes** (Kirkaldy).
   Vertex about one-third or distinctly more than one-third as long as interocular breadth, its median length slightly to distinctly longer than length at fore edge of an eye as seen from above; length 2 to 4 mm..................... 3

3(2). Vertex comparatively long and pointed (fig. 24, c), slightly more than one-half as long as interocular breadth..... .... **timberlakei** (Osborn).
   Vertex shorter and more rounded....................... 4

4(3). Vertex, pronotum and scutellum with pale-brown vittae and/or maculae, grill on front fairly conspicuous for this group; length 2.5–3.0 mm......**volcanicola** (Kirkaldy).
   Without such a distinct color pattern, grill faint or absent... 5

5(4). Length less than 3 mm.; front with a faint grill; clypeus parallel-sided, its apex completely rounded.... .. .. **peregrina** (Kirkaldy).
   Length 3 mm. or more; grill on front usually indistinguishable; clypeus slightly but distinctly expanded distad, its apex rounded but blunted or almost slightly concave at tip........................**plutonis** (Kirkaldy).

Balclutha hospes (Kirkaldy), new combination (fig. 24, b).

Nesosteles hebe variety *hospes* Kirkaldy, 1910:574.

Nesosteles hospes (Kirkaldy) Timberlake, 1918:381.

Osborn, 1935:57, figs. 24, *a, b,* male internal genitalia.

Endemic. Kauai, Oahu, Maui, Hawaii (type locality: Kilauea).

Hostplant: "coarse grass."

Timberlake (1918:381) noted that the specimens from Fiji, Australia and Hawaii lumped by Kirkaldy under the name for the Fijian form, *hebe,* each represented a distinct species and gave notes on the male genitalia.

There has never been a type selected for this species. There is in Perkins' collection at the Bishop Museum a single specimen bearing Kirkaldy's label "hebe ?" written in pencil on a torn bit of paper. It was collected by Perkins at Kilauea, July, 1906. I have designated this example from Kirkaldy's original series as the type and have so labeled it and stored it in the Bishop Museum.

This species has been taken abundantly in light traps near Pearl Harbor.

Balclutha kilaueae (Kirkaldy), new combination (figs. 7, a; 11, d–f).

Macrosteles kilaueae Kirkaldy, 1910:575.

Cicadula kilaueae (Kirkaldy) Osborn, 1935:55.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: *Cibotium chamissoi.*

This species has been a puzzle to us ever since it was described. The unique female holotype which Osborn supposed was in the British Museum is in the Bishop Museum. Osborn confused *Balclutha timberlakei* with this species (at least some material he identified when he worked over the Hawaiian Cicadellidae was confused), and he assigned it to *Cicadula*. On the eve of going to press, I fortunately discovered a series of topotypic specimens collected by Dr. Swezey and have been able to clarify the confused situation.

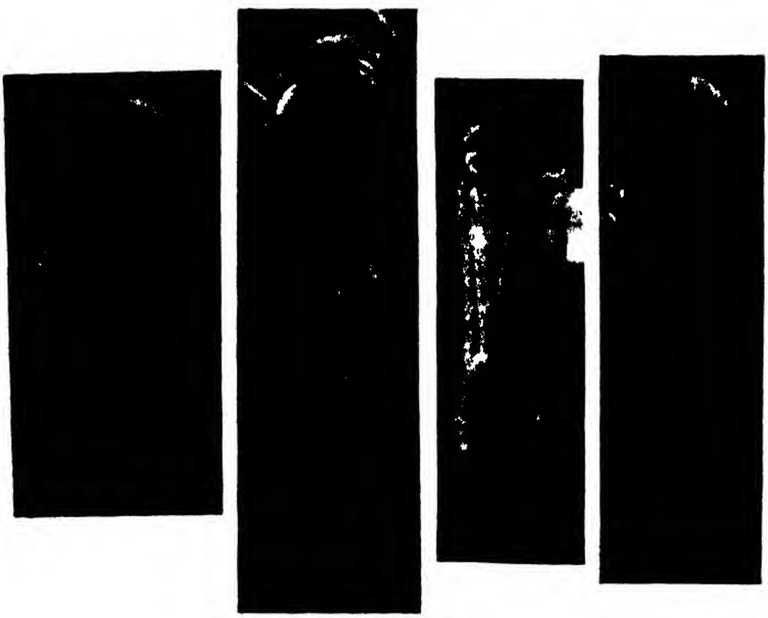

Figure 27—Some cicadellids. Left to right: *Balclutha peregrina* (Kirkaldy); *Balclutha plutonis* (Kirkaldy); *Balclutha volcanicola* (Kirkaldy); *Empoasca solana* DeLong. (Not to same scale.)

Balclutha peregrina (Kirkaldy), new combination (fig. 27).

Nesosteles peregrina Kirkaldy, 1910:575. Osborn, 1935:59, fig. 24, *c*, male internal genitalia.

Endemic. Oahu, Hawaii (type locality: Kilauea).

Kirkaldy considered this species as a probable immigrant; perhaps some of the specimens he examined were taken at lights in Honolulu.

The type, from Perkins' collection, is in the Bishop Museum.

Balclutha plutonis (Kirkaldy), new combination (fig. 27).

Nesosteles plutonis Kirkaldy, 1910:574. Osborn, 1935:57, fig. 24, *d,* internal male genitalia.

Endemic. Oahu, Molokai, Hawaii (type locality: Kilauea).

The type is now in the Bishop Museum. The mount originally held two specimens and bears the following labels written by Perkins: "*N. ignigena* MS–*plutonis* type, Kilauea, VII-06" and "The other specimen was possibly removed by K[irkaldy] for examination of wings. I did not find it."

Balclutha timberlakei (Osborn), new combination (figs. 7, e; 24, c).

Nesosteles timberlakei Osborn, 1935:59, figs. 25, *a–c.*

Endemic. Oahu (type locality: Palolo Valley).

Hostplant: *Eragrostis variabilis.*

Osborn evidently confused this species, in part, with *kilaueae* (Kirkaldy).

The type is in the Bishop Museum.

Balclutha volcanicola (Kirkaldy), new combination (fig. 27).

Nesosteles volcanicola Kirkaldy, 1910:574. Osborn, 1935:58, fig. 24, *e,* internal male genitalia.

Endemic. Maui, Hawaii (type locality: Kilauea).

Hostplant: *Eragrostis.*

The type from Perkins' collection is in the Bishop Museum.

Genus **NESOLINA** Osborn, 1935:60

Osborn's original description of the genus reads, "Similar to *Cicadula* in venation but with the head more deltocephaloid. Vertex, produced, angular; front flattened, tapering to clypeus which is narrow, nearly twice as long as wide; elytra narrow, two anteapical, four apical areoles." Osborn failed to call attention to the fact that as on *Balclutha* the "first sector of the elytra fuses with the second near the fork," thus forming a cell. But in this case the vein and the cell are distinctly developed and conspicuous. Therefore, it appears that the venation is more like that of *Balclutha* than it is like that of *Cicadula.* The illustrations show this clearly.

The prolonged and pointed head together with the wing venation will serve to distinguish this genus readily from our other cicadellids.

Nesolina lineata Osborn (figs. 7, d; 8, e, f; 24, d).
Nesolina lineata Osborn, 1935:60, figs. 26, *a–c*. Genotype.

Endemic (?). Oahu (type locality: Diamond Head, Honolulu), Hawaii.

Hostplant: *Eragrostis variabilis.*

This is a striking species. The dorsum including the head, pronotum and tegmina is conspicuously vittate. The veins of the tegmina are white, and the cells bear the brown coloring of the vittae.

The head of the nymph is conspicuously different from that of the adult, as the illustration on page 30 shows. It recalls the form of the heads of certain Mallophaga, and is characteristic. The nymphs do not have long erect bristles on the abdominal tergites.

The type is in the Bishop Museum.

Family **MEMBRACIDAE** Germar, 1821

The Treehoppers

This large, widespread family is represented in our Territory by only two immigrant species. They may be readily distinguished from all of the associated groups in Hawaii because of the greatly enlarged pronotum which is produced back over the abdomen into a long point, the scutellum is concealed and the vertex and front of the head are continuous and vertical. Both adults and nymphs are agile jumpers. The eggs are inserted in slits cut into plant tissue.

Funkhouser (1927) has published a catalogue of the Membracidae of the world.

Key to the Genera of Membracidae Found in Hawaii

1. Sides of pronotum not produced into horns; green or yellowish species, not conspicuously hirsute above...... **Stictocephala** Stål.
2. Each side of the pronotum produced into an outstanding pointed horn; dark-colored species, conspicuously hirsute above.................................. **Tricentrus** Stål.

Subfamily SMILIINAE (Stål, 1866)

Tribe CERESINI Goding, 1892

Genus **STICTOCEPHALA** Stål, 1869

This is an American genus, and most of the species are recorded from the United States.

Stictocephala festina (Say) (fig. 28).
Membracis festina Say, 1830:243.

Oahu, Molokai, Maui, Lanai.

Immigrant. A widespread species in the United States; described from Florida. First found in Hawaii at Honolulu by Hadden in 1925.

Hostplants: alfalfa, *Crotalaria,* garden beans (occasionally heavy infestations), grasses, *Leucaena,* potato, *Tribulus cistoides.*

Parasite: *Gonatocerus ornatus* Gahan (Hymenoptera: Mymaridae), in the eggs.

This species has been reported as a pest of alfalfa in the United States; in Hawaii it is a minor bean pest. In life it is bright green, but it changes to brownish-yellow when stored in collections. For an illustrated discussion of the species on the United States mainland, see V. L. Wildermuth, 1915:343.

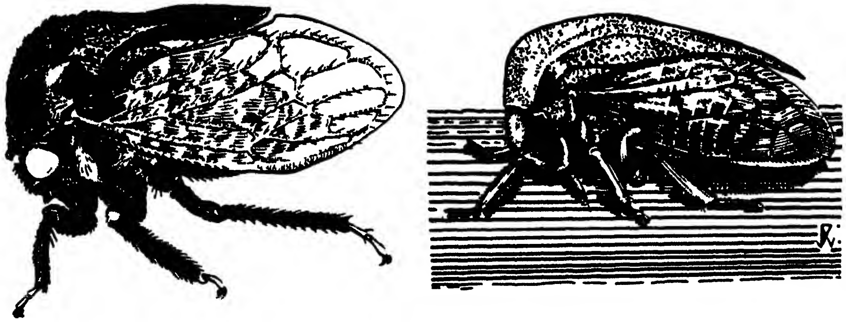

Figure 28—*Tricentrus albomaculatus* Distant, left (Abernathy drawing); *Stictocephala festina* (Say), right (Williams drawing, 1931).

Subfamily CENTROTINAE (Spinola, 1850)

Genus **TRICENTRUS** Stål, 1866

This is a large Indo-Pacific genus.

Tricentrus albomaculatus Distant (fig. 28).
Tricentrus albomaculatus Distant, 1908:56.

Oahu.

Immigrant. A widespread species described from India and ranging to Singapore. First found in Hawaii by Swezey in 1912 on the lower slopes of Mount Tantalus, Honolulu.

Hostplants: *Cajanus indicus* (pigeon pea), *Canangium odoratum* (ylang-ylang or ilang-ilang), *Cassia bicapsularis*, *Eucalyptus*, *Sesbania*.

This species is easily recognized because of its prothoracic horns. Kershaw (1913:186) published an account of the alimentary canal.

Superfamily FULGOROIDEA Kirkaldy, 1907

The Fulgoroid Leafhoppers

See Muir, 1923:205, for detailed discussion.

Key to the Families Found in Hawaii

1. Hind tibiae each with a very large movable apical spur or calcar .... **Delphacidae.**
   Hind tibiae with variable spines but never with such a spur.... 2
2. Body greatly compressed laterally; wings held vertically with the apices contiguous or nearly so; clavi with distinct granules .... **Flatidae.**
   Body not laterally compressed; apices of wings strongly divergent dorso-ventrally at apices; clavus not granulate... **Cixiidae.**

Family **CIXIIDAE** (Spinola, 1839)

The Cixiids

This world-wide family contained 84 genera and 786 species in 1936, according to Metcalf's (1936) world catalogue, and is thus one of the larger fulgoroid families. It is represented in the autochthonous Hawaiian fauna by two genera containing 84 forms. The group contains the largest (up to a centimeter or more in length) and most conspicuous of all of the native Hawaiian leafhoppers. Also, many of the species are fairly abundant and conspicuous in the native forests.

Their large size together with the absence of a large, specialized, movable tibial spur, and the wings held broadly $\wedge$-like over the abdomen will readily serve to distinguish them from all other Hawaiian fulgoroids.

The most primitive of living fulgoroids belong to this family. Most of the species of the two genera found in Hawaii have three ocelli, although the median ocellus is obscure in some.

The native *Nesomimesa* wasps include these homopterans in their list of provisions for their nests.

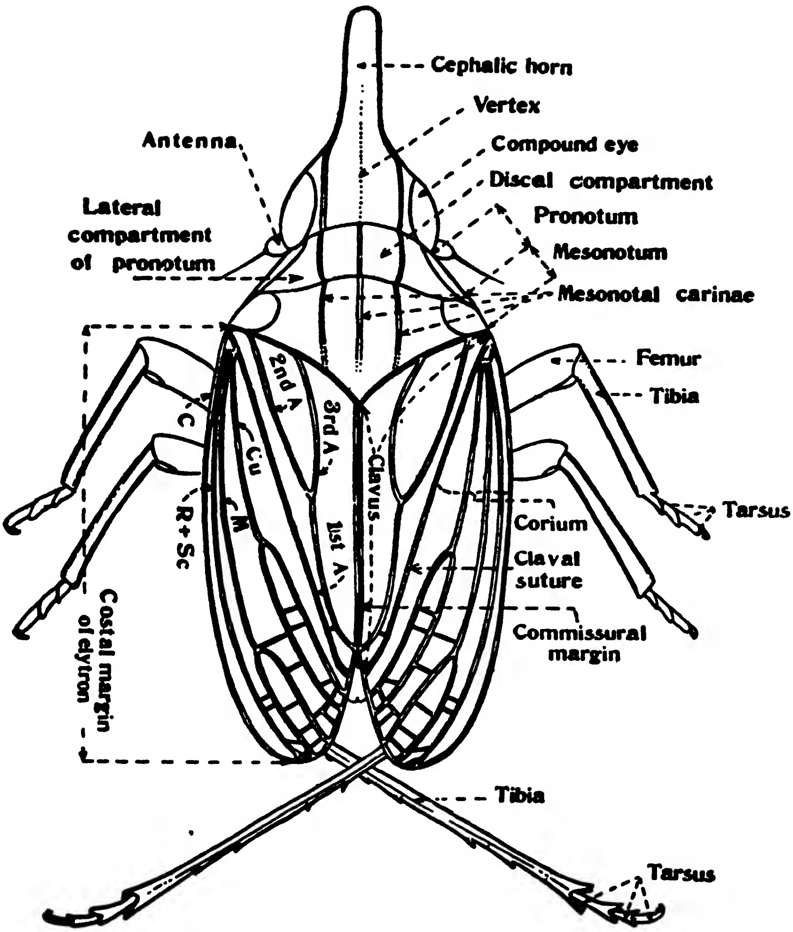

Figure 29—Diagram illustrating characters of a fulgorid leafhopper. (After Van Duzee, 1923.)

Subfamily CIXIINAE Muir, 1923:222

Tribe CIXIINI Muir, 1923:222

Key to the Cixiid Genera of Hawaii

1. Mesonotum with five longitudinal carinae.......... **Oliarus** Stål.
2. Mesonotum with only three longitudinal carinae........... .... **Iolania** Kirkaldy.

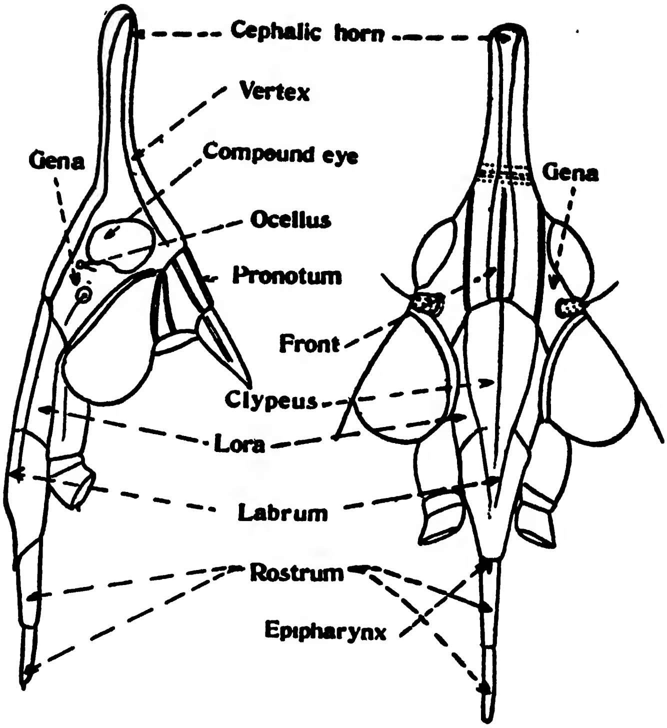

Figure 30—Diagrams of fulgorid head characters. (After Van Duzee, 1923.)

Genus OLIARUS Stål, 1862

Nesoliarus Kirkaldy, 1909:76. New synonym.
See Metcalf, 1936:44, for synonymy and world catalogue.

This genus contains about 295 forms and is the largest of the family. The 78 forms found in Hawaii make this the richest single faunal unit. The genus is most abundantly developed in the Indo-Pacific regions, is well represented in the Holarctic region, but few species have been recorded from Africa or South America.

Kirkaldy (1909:76) erected the subgenus *Nesoliarus* for the Hawaiian species. His reasons for separating the Hawaiian forms into a group by themselves are as follows:

> So far as concerns the structure of the legs, the Hawaiian forms all belong to the typical subgenus, but I separate them off under the name *Nesoliarus,* on account of the great plasticity of those characters which are of specific value in the exotic forms, and on account of the sexual dimorphism, which is more or less apparent—mostly considerably so—in the pattern and colouring of the tegmina. As it would not be possible to include these Hawaiian forms in a general table of species, owing to the above-mentioned plasticity, it is convenient to group them under a special subgeneric name (type *tamehameha*). (1909:76.)

Muir (1925:161) said that *Nesoliarus* "is purely a geographical subgenus and is of great convenience, as it segregates a number of species, varieties and forms,

which are closely allied and monophylatic[*sic*]; among them we find some forms that could go into the typical subgenus *Oliarus* and others into *Nesopompe*."

I feel, however, that the use of *Nesoliarus* serves no good purpose, and it is not used in this text. A subgeneric name should have something more substantial than mere "convenience" to back it up.

There is a considerable range of variability of various structural characters in the Hawaiian species. Kirkaldy (1909:76) said, "The venation, which in the Australian and Fijian species I found so characteristic, is highly variable in the Hawaiian forms. The place of forking of the radial and brachial veins, and the place of union of the two claval veins, which characters seem to be of specific value in exotic forms, are inconstant and of no value here." Giffard (1925) noted great individual variation in the number of spines on the hind tibiae, a character found useful for specific segregation elsewhere, and he outlined other variations.

Thus, this group shares with the other large Hawaiian genera the great plasticity of form and structure that is so typical of this insular fauna.

Little is known of the biology of these insects. Nymphs have been found in Hawaii beneath stones, in rotting tree fern stumps and fronds, in tree fern ground litter, in rotting wood and under the bark of trees. It is thought that they feed upon fungi or rotting vegetation or plant sap, but nothing certain is known of their food habits. Hacker (1925:113) reported upon the life history of the Australian species *O. felis* Kirkaldy, which he found in cracks in soil about *Sporobolus* bunch grass, and published some excellent photographs of the eggs, nymphs and adults.

Swezey has made some observations on the nymphs of what he considered to be *Oliarus koanoa* (1907:83), and many of his data are worthy of quotation. He found the nymphs, which were reared to maturity, "among the decaying leaf-bases and fibrous material of tree-fern trunks."

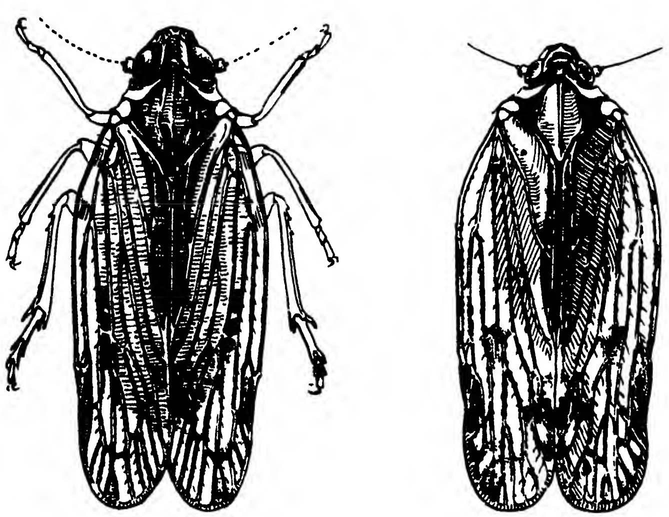

Figure 31—*Oliarus tamehameha* Kirkaldy, female, left; *Iolania perkinsi* Kirkaldy, female, right. (Drawings by Abernathy.)

The nymphs were in cavities or tunnels lined with a white fibrous material which resembled mold, or spider's web, and which is an excretion from the terminal abdominal segments of the nymph. Each nymph had a tuft or brush of straight fibers of this material, extending backward and slightly upwards, and spread somewhat fan-shaped. It is probably rubbed off accidentally in the movements of the insects, and serves to aid in hiding or protecting it. It is rapidly replaced. A specimen from which it was entirely removed, had it completely produced again within 24 hours.

The full-growth nymph is about 5 mm. long, and 2 mm. wide, about even width throughout; the tuft is from 2 to 5 mm. Whole insect whitish, with pale greyish markings on the thorax, and 5 dorsal bands on the abdomen in front of the cottony tuft. Eyes dark brown, partially hidden behind projecting margins of the frons. Rostrum extends beyond 2nd abdominal segment. Sensory pits are very numerous; a row near the margin of frons, many on dorsal part of thorax and wing cases, a transverse dorsal row on abdominal segments 2, 3 and 4. The abdomen is obliquely truncated behind the 4th segment, so that the dorsal surfaces of segments 5, 6 and 7 are directed nearly posteriorly. These contain the numerous pores from which the fibers of the tuft are extruded.

The nymphs probably feed upon the fern roots in the fibrous mass of the outside of the fern trunks, or on juices of the decaying material. The largest nymphs collected transformed to adults in a few days. (1907:83–84.)

The adult females have the end of the abdomen greatly modified into a broad, concave plate-like area (see fig. 34, a), from which a flocculent white wax is exuded in myriads of filaments to form a great white mass. The eggs, which are deposited in clusters, are enclosed and concealed by a mass of the white wax. Swezey found a clutch of eggs on a bracket fungus on a koa log, and he reported (*Proc. Hawaiian Ent. Soc.* 5(3):365–366) that "There were about a dozen of the oval white eggs loosely enclosed beneath what had the appearance of a small bit of lichen. The inner edge of this was composed of white, waxy material usually found at the apex of the abdomen of the female *Oliarus;* the outside was greenish as if covered by a minute growth of lichen."

This is a difficult genus containing many variable and confusing forms. Although Giffard spent much time studying the group and had the guidance of the experienced hemipterist, F. A. G. Muir, the present arrangement of the genus is not satisfactory. I have deemed it outside the scope of my present experience to attempt any detailed revisionary work here, and I leave the problem for some future monographer skilled in the study of the fulgorids to present a revised classification. However, certain obvious points permit or require statements of opinion herewith.

Giffard sorted out various forms from certain variable species and designated them as varieties. He did not name them, but gave them *a, b, c,* etc., designations and selected types for some of them. For example, he listed varieties *a* to *f* of his *Oliarus instabilis,* a highly variable species. However, he was inconsistent, for he described varieties of certain other species without giving them any alphabetical designations, although the sum of their variation appears to be of equal rank to those to which he applied indicating letters. I do not believe that Giffard fully understood the limits of individual variation among the species, and it appears that in at least some of his cases, the species normally include, within their populations, individual variables which should not be named. Perhaps the situation

can be likened to litters of cats, no two individuals of which may be identical. Metcalf, unfortunately, has made matters worse, for, in his catalogue of the Cixiidae, he has chosen to erect names for Giffard's varieties, although he did not examine Giffard's material and thus could not evaluate properly the various problems. I believe that it would perhaps be best to relegate these varietal designations to synonymy. However, as above stated, I feel that such revisional work is really outside the scope of my present problem, and inasmuch as my studies in this genus can hardly be termed more than cursory, I feel that it is best to leave the names in *status quo* until the genus can be revised in detail.

The following six Kirkaldy species were unknown to Giffard, and I, too, have not seen them; they are not included in the following tables: *O. procellaris, O. pluvialis, O. monticola, O. paludicola, O. nemoricola, O. orono.* Three of these species are, however, illustrated here from drawings made from the holotypes at the British Museum. Giffard gives notes on these forms (1925:147–149), and it is probable that he has unknowingly redescribed some of Kirkaldy's species.

The divisions erected by Giffard on the basis of the characters of the vertex are not satisfactory because of intergradation or obscurity of the parts involved.

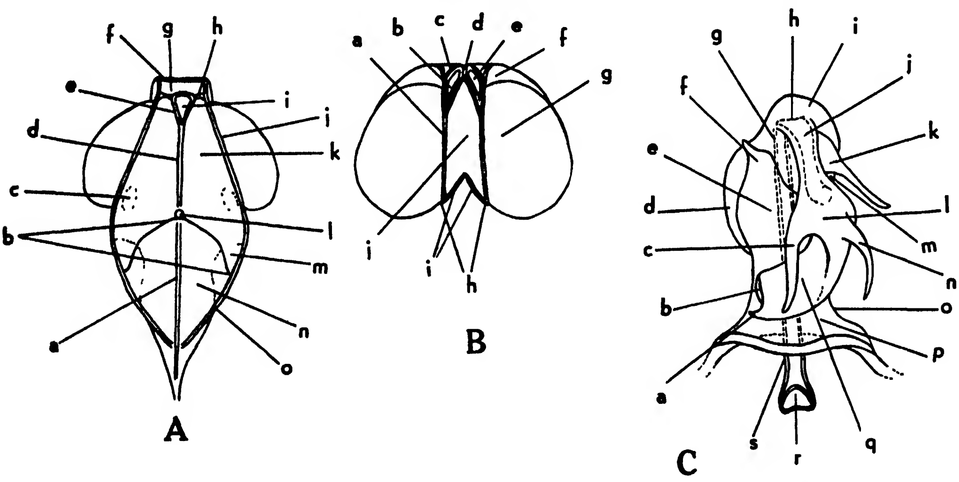

Figure 32—Details of *Oliarus*. **A**, frontal view of frons and clypeus of head of *Oliarus euphorbiae* Giffard: **a**, median carina of clypeus; **b**, fronto-clypeal suture (apex of frons and base of clypeus); **c**, fenestra; **d**, medio-frontal suture; **e**, fork of medio-frontal suture; **f**, transverse carina of vertex; **g**, fossette of vertex; **h**, apex of vertex; **i**, areolet of fork of medio-frontal suture; **j**, lateral carina of frons; **k**, frons; **l**, median ocellus; **m**, macula; **n**, clypeus; **o**, lateral carina of clypeus.

B. Dorsal view of head of *Oliarus swezeyi* Giffard: **a**, lateral carina of vertex; **b**, transverse carina of vertex; **c**, apical carina of vertex; **d**, median longitudinal carina of vertex; **e**, areolet (divided fossette); **f**, upper part of gena; **g**, eye; **h**, basal angles of vertex; **i**, base of vertex; **j**, vertex (including fossette).

C. Dorsal view of aedeagus of *Oliarus acaciae* Kirkaldy: **a**, right apical spur; **b**, functional orifice; **c**, right median spur; **d**, membranous part of periandrium; **e**, periandrium; **f**, apex of periandrium; **g**, apodeme of phallus; **h**, conjunctiva; **i**, membranous part of periandrium; **j**, basal part of phallus; **k**, basal spur of phallus attached to membrane (behind); **l**, phallus; **m**, membranous part of periandrium; **n**, left median spur; **o**, side margin of periandrium; **p**, base of periandrium; **q**, apical part of phallus; **r**, entrance of ejaculatory duct; **s**, apodeme of phallus. (Redrawn from Giffard, 1925.)

Some future monographer should find a more satisfactory method of dividing the species. As it stands, the key may be found confusing and misleading. On some examples the characters of the vertex are difficult to make out, whereas on other examples they may be clear-cut and can fit comparatively easily into their proper places in the keys.

Giffard's divisions are, in my opinion, largely meaningless phylogenetically. Obviously closely related species have been placed by him in different divisions and widely separated in his text. *O agnatus* and *O. koele* are herein synonymized, after a study of the holotypes, yet Giffard made no mention in his text that the "species" were allied, and he placed *agnatus* in division "E" and *koele* in division "C."

The following key is a recast and somewhat revised version of Giffard's key to the species. Following this key is a set of new keys which may be found more easily used. The substance of Giffard's key (1925) is given here for the sake of completeness and to follow the only revision of the group. I have not included the

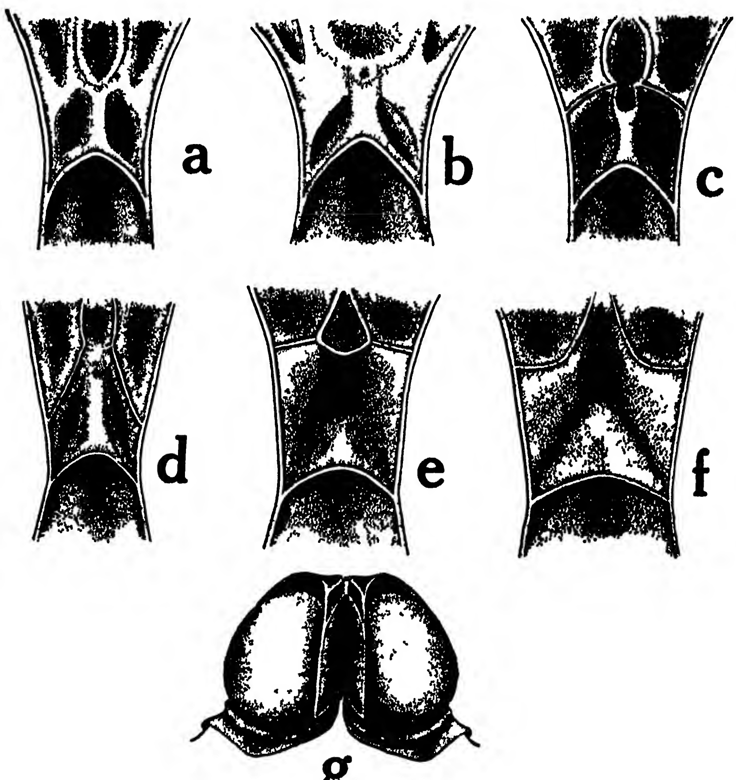

Figure 33—Details of fossettes and bases of frons of *Oliarus* to show key characters. **a**, *O. tantalus* Giffard (Division B); **b**, *O koanoa* Kirkaldy (Division B); **c**, *O. nubigenus* Kirkaldy (Division C), **d**, *O immaculatus* Giffard (Division D); **e**, *O. hevaheva* Kirkaldy (Division E); **f**, *O. kulanus* Giffard (Division E); **g**, *O. swezeyi* Giffard, head from above (Division A) (Rearranged from Giffard, 1925)

various "varieties" in the keys; Giffard's original descriptions should be consulted for notes regarding them.

Key to the Divisions of Hawiian Oliarus

1. Fossette of vertex completely divided by a median longitudinal carina, thus forming two areolets.............. 2
   Fossette of vertex either not divided or else incompletely divided by a median longitudinal carina............... 4

2(1). Areolets of vertex very acutely angulate posteriorly, much longer at sides than at middle................**Division A.**
   Areolets much less acutely angular posteriorly, length at sides not much greater than in middle................. 3

3(2). Areolets sub-ovate, and either base of frons or else edges of areolets (or both) more or less tumescent and largely obscuring apical carinae of vertex.............**Division B.**
   Areolets usually somewhat subquadrate and/or base of frons and carinae not or but slightly tumescent so that apical carinae are distinct (Note: This dichotomy is not very satisfactory and you may have to try each section.) ....**Division C.**

4(1). Fossette incompletely divided, basal part of dividing carina more or less evident, but never reaching apical carinae of vertex.................................**Division D.**
   Fossette of vertex entirely undivided or with only a rudimentary basal part of dividing carinae.........**Division E.**

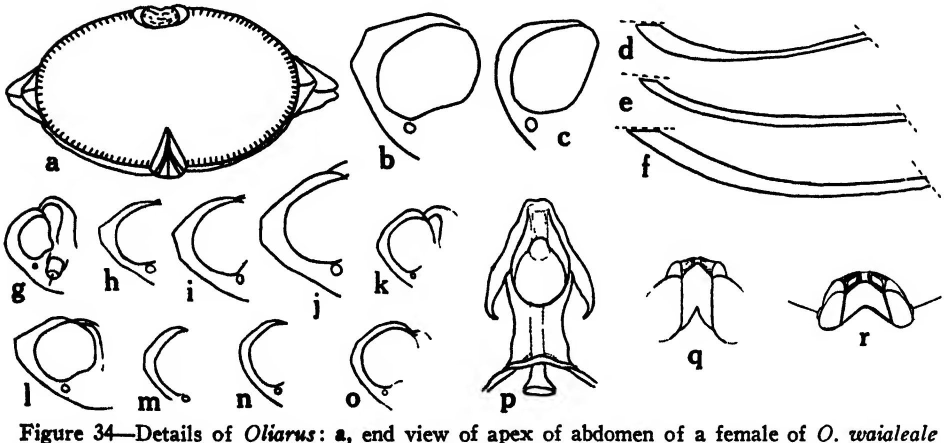

Figure 34—Details of *Oliarus*: **a**, end view of apex of abdomen of a female of *O. waialeale* Giffard to show the greatly modified plate from which wax is extruded (anus at top, ovipositor at bottom, concave plate between); **b**, profile of head of male of *O. similis* Giffard to show outline of gena and vertex; **c**, the same of *O. koele* Giffard, male; **d**, costa of *O. hevaheva* Kirkaldy to show basal expansion on convexity of lateral margin; **e**, the same of *O. kauaiensis* Kirkaldy; **f**, the same of *O. niger* Giffard; **g**, lateral view of head of female of *O. discrepans* Giffard; **h**, the same of *O. instabilis* Giffard; **i**, the same of *O. olympus* Giffard; **j**, the same of *O. tamehameha* Kirkaldy; **k**, the same of *O. muiri* Giffard; **l**, the same of *O. silvestris* Kirkaldy; **m**, the same of *O. filicicola* Kirkaldy; **n**, the same of *O. koele* Giffard; **o**, the same of *O. swezeyi* Giffard; **p**, male genitalia of *Iolania perkinsi* Kirkaldy; **q**, dorsal view of head of *Oliarus kirkaldyi* Giffard; **r**, the same of *O. discrepans* Giffard, female. (**a–f**, original; **g–r**, after Giffard, 1925.)

These divisions are not as clear-cut as one might expect them to be. In fact, there appears to be a blending among them. It is often difficult to decide the category to which one's examples should be assigned. Some individuals have the characters obscurely developed, but on others they are clearly defined.

DIVISION A

Fossette of vertex completely divided by a median longitudinal carina which forms two areolets. Areolets elongated and very acutely angulate caudad, much longer at sides than at middle. Kauai species (fig. 33, g).

1. Vertex broader at extreme base than breadth of an eye at same level; tegmina clear or yellowish hyaline.........**muiri** Giffard.
2. Vertex only about two-thirds or less as wide at extreme base as breadth of an eye; tegmina milky hyaline....**swezeyi** Giffard.

DIVISION B

Fossette of vertex completely divided by a median longitudinal carina forming sub-ovate areolets. Areolets much more obtusely angular posteriorly than in division A, length at sides of areolets not much greater than along the median carina. Base of frons or edges of areolets, or both, more or less tumescent and in great measure obscuring apical carinae of vertex. Excavate area small (fig. 33, a, b).

1. Vertex very broad, almost twice as broad at base as median length to transverse carina............**discrepans** Giffard.
   Vertex much narrower................................ 2
2(1). Costa particolored; length: male, 6–7 mm.; female, 7–8 mm.; Oahu...........................**kaiulani** Giffard.
   Costa unicolored.................................. 3
3(2). Tegminal veins particolored........................... 4
   Tegminal veins not particolored........................ 7
4(3). Breadth of extreme base of vertex greater than breadth of an eye.......................female **kirkaldyi** Giffard.
   Base of vertex narrower............................ 5
5(4). Mesonotum pale castaneous; length: male, 6 mm.; female, 7 mm.; Oahu (and female *wailupensis* Giffard ?)...... ....**kaumuahona** Giffard.
   Mesonotum dark castaneous.......................... 6
6(5). Cross-veins seldom suffused; tegmina clear hyaline or not very distinctly milky, males always maculate; length: 6–8 mm.; Hawaii.....................**koanoa** Kirkaldy.
   Cross-veins always suffused; tegmina milky hyaline; males immaculate, females maculate; length: male, 4.5–5.25; female, 6 mm.; Oahu...............**myoporicola** Giffard.
7(3). Tegminal veins dark; tegmina immaculate cloudy or bronzy hyaline; length: male, 6.75–7 mm.; female, 7.5–8 mm.; Oahu......................**tantalus** Giffard.
   Tegminal veins comparatively pale..................... 8

8(7). Extreme breadth across base of vertex distinctly more than one-half as great as median distance from a line drawn across base to transverse carinae.........**kirkaldyi** Giffard.
Extreme breadth of vertex at base less than one-half as long as median length from a line drawn across extreme base to transverse carinae............................ 9
9(8). Length 4.5–5.5 mm.; tegmina of male and female clear hyaline, immaculate; Oahu............**wailupensis** Giffard.
Length 6–7 mm.; tegmina of male clear hyaline, immaculate; female maculate; Hawaii...........**koanoa** Kirkaldy.

DIVISION C

Fossette of vertex completely divided by a median longitudinal carina (this carina forked or minutely annulate anteriorly in some species) forming subquadrate areolets. Base of frons and carinae not tumescent as in division B, or only slightly so and the excavate area larger and more distinct than in that group (fig. 33, c).

1. Basal and apical third of tegmina darkly fuliginous, middle third clear or milky hyaline; length: male, 5–5.5 mm.; Oahu..........................**neotarai** Giffard.
Usually larger species; tegmina not so colored, not divided into three color areas.......................... 2
2(1). Tegmina of males and females clear or milky hyaline, without any yellowish tinge (none from Lanai)........ 3
Tegmina of males yellowish, ochraceous, or tawny hyaline; females with tegmina darker yellowish to fuliginous, immaculate.................................. 9
3(2). Mesonotal carinae dark............................ 4
Mesonotal carinae pale............................. 5
4(3). Kauai species.......................**nubigenus** Kirkaldy.
Hawaii species.......................**filicicola** Kirkaldy.
5(3). Kauai or Hawaii species.......................... 6
Oahu or Maui species.............................. 7
6(5). Kauai species; tegmina of male immaculate, of female maculate; length: 10.5–11 mm......**tamehameha** Kirkaldy.
Hawaii species; both sexes immaculate; length: male, 5–6.5 mm.; female, 7–7.25 mm.........**filicicola** Kirkaldy.
7(5). Cross-veins distinctly suffused; length: male, 5.25 mm.; Oahu.............................. **makaala** Giffard.
Cross-veins not or only slightly suffused................ 8
8(7). Length: male, 6.5–7.5 mm.; female, 7–9 mm.; particoloration of veins comparatively pale........**pele** Kirkaldy.
Length: male, 5.5–6 mm.; female, 7 mm.; particoloration of veins comparatively dark..........**likelike** Giffard.
9(2). Oahu species; mesonotum pale to dark castaneous...... ....**kaonohi** Kirkaldy.
Not so 10

10(9). Lanai species; mesonotum flavous to dark castaneous.. ....**koele** Giffard.
Not so..11
11(10). Maui species; mesonotum flavous to fusco-piceous..... ....**halehaku** Giffard.
Hawaii species; mesonotum flavous to dark castaneous ....**filicicola** Kirkaldy.

DIVISION D

Fossette of vertex incompletely divided by a median longitudinal carina, the basal part of the dividing carina more or less evident, but never reaching the apical carinae of the vertex (fig. 33, d).

1. Discal tegminal veins dark............................ 2
Discal tegminal veins pale............................ 6
2(1). Tegmina with about basal and apical thirds darkly fuliginous, middle third largely clear or milky hyaline...... 3
Tegmina not so colored and not divided into three colored areas 4
3(2). Small species, length: males, 5–5.5 mm.; females, 6–6.5 mm. ....**neotarai** Giffard.
Larger, males, 6.5–7.25 mm.; females, 7.5–8 mm......... ....**tarai** Kirkaldy.
4(2). Tegmina yellowish or tawny, with apical third more or less fuliginous..................female **neomorai** Giffard.
Tegmina entirely dark fuliginous, opaque................ 5
5(4). Molokai species; length: male, 7.25–7.75 mm.; female, 8.5–9 mm.............................**morai** (Kirkaldy).
Kauai species; length: female, 8 mm................. ....variety of **immaculatus** Giffard.
6(1). Base of fork of medio-frontal carina open (obsolete); tegmina immaculately dark yellowish, semi-opaque; length: male, 7 mm.; female, 8 mm.; Kauai only............. ....**immaculatus** Giffard.
Base of fork of medio-frontal carina closed; tegmina yellowish or tawny hyaline, with apical third or less fuliginous; length: male, 7.5 mm.; female, 9 mm.; on all islands.............................**neomorai** Giffard.

DIVISION E

Fossette of vertex entirely undivided by a median longitudinal carina, or, at most, the basal part of the carina when present is rudimentary or obscure (fig. 33, e, f).

1. Costa, as seen from above or from side (not from below) obviously much expanded toward base, sometimes nearly flange-like (fig. 34, d, f), distinctly much

broader than at middle and in some species strongly convex in tegminal outline 2
Costa not or but slightly broadened toward base, only slightly broader at base than at middle, never strongly convex basad (fig. 34, e) 7

2(1). Costa not conspicuously arched basad, more flatly arcuate (fig. 34, f) 3
Costa distinctly and comparatively strongly arched basad (fig. 34, d) 4

3(2). Tegmina milky hyaline; wings hyaline; costa not so thick at base as in some other species; tegminal veins very dark; length: males, 6.5–7 mm.; females, 7.5–7.75 mm.; Hawaii .... **niger** Giffard.
Tegmina dark yellowish or tawny hyaline, maculate; wings apically fuliginous; length: male, 9.25 mm.; Maui .... **haleakalae** Kirkaldy.

4(2). Mesonotal carinae black or dark castaneous 5
Mesonotal carinae comparatively pale castaneous 6

5(4). Kauai species .... **montanus** Giffard.
Oahu species .... **olympus** Giffard.
Lanai and Hawaii species .... **hevaheva** Kirkaldy.

6(4). Oahu species .... **olympus** Giffard.
Maui species .... **mauiensis** Giffard.
Hawaii species .... **hevaheva** Kirkaldy.

7(1). Tegminal veins particolored (comparatively large species, 7–12 mm. in length) 8
Tegminal veins not particolored (usually smaller species, length of males seldom more than 7 mm.) 12

8(7). Oahu species .... **kaohinani** Kirkaldy.
Hawaii species .... **kanakanus** Kirkaldy.
Not so 9

9(8). Kauai species 10
Maui or Molokai species 11

10(9). Sides of vertex only slightly expanded basad (apex divided into breadth across basal angles in holotype male equals 1.18); length: male, 7 mm.; female, 9 mm. .... **consimilis** Giffard.
Sides of vertex obviously divergent basad (apex divided into breadth between basal angles equals 1.41 in male holotype); length: male, 8 mm.; female, 10 mm. .... **intermedius** Giffard.

11(9). Fossette of vertex a little longer than wide; base of fork of median frontal carina closed; length: 8 mm. .... **kahavalu** Kirkaldy.
Fossette of vertex a little broader than long; base of fork of median frontal carina open; length: male, 10 mm.; female, 11.5–12 mm. .... **kulanus Giffard.**

12(7). Tegmina maculate 13
Tegmina immaculate 17

13(12). Mesonotal carinae dark 14
Mesonotal carinae pale 16

14(13). Basal two-thirds of tegminal veins mostly pale; darkly fuliginous over basal third of tegmina.......**lihue** Giffard.
Basal two-thirds of tegminal veins dark and pale, but not particolored; not darkly fuliginous over basal third of tegmina..15

15(14). **O. waialeale** Giffard, and **kauaiensis** Kirkaldy. The holotype and lectotype of these two species are so closely similar that I cannot separate them. I do not now feel that they are distinct species, but consult Giffard's text.

16(13). Kauai species.............................**koae** Giffard.
Oahu species..........................**acaciae** Kirkaldy.
Maui species........................**euphorbiae** Giffard.
Hawaii species.........................**opuna** Kirkaldy.
Note: The above forms all have the fossette broader than long. They may only be forms of a single species.

17(12). Mesonotum pale (tegmina broad, veins lightly particolored and medianly pallid; length: male, 5.25 mm.; Kauai)............................ **halemanu** Giffard.
Mesonotum dark.......................................18

18(17). Tegmina and wings conspicuously and unusually milky white; at least outer mesonotal carinae pale; Oahu ....**albatus** Giffard.
Not so..19

19(18). Kauai species (yellowish macula at lateral margins of frons near clypeal suture distinct and elongate; tegmina hyaline, veins dark)...........**silvestris** Kirkaldy.
Not Kauai species...................................20

20(19). Oahu species..........................**instabilis** Giffard.
Not so..21

21(20). Maui or Lanai species....................**similis** Giffard.
Hawaii species.....**inaequalis** Giffard and **inconstans** Giffard.
I do not understand why Giffard separated these last two forms as distinct species. I have been unable to find specific differences between them, and Giffard did not give characters to separate them in his key.

Inasmuch as Giffard's keys, even as herein altered and recast, are difficult to use and may greatly confuse the student unfamiliar with the group, especially if he does not have an adequate, carefully named collection for comparative purposes, I have felt it desirable to draw up tentative supplementary keys. These have been prepared using distribution as a primary divisional character, for most of the species are known from single islands only. These keys will have to be altered in the future when more data are available regarding distribution, but in the meantime they may aid in the identification of localized collections of these difficult and confusing forms. The keys are based upon the males and have been drawn up from the type specimens of most of the species.

Island Keys to the Male Oliarus

KAUAI SPECIES

(Excepting *orono* and *pluvialis,* but see figure 35, c, d of the latter)

1. Areolets of vertex unusually prolonged caudad into slender points as in figure 33, g, much longer at sides than along median line 2
   Areolets not so formed, never so prolonged backward 3

2(1). Vertex broader across basal angles than breadth of an eye at same level; tegmina clear or yellowish hyaline .... **muiri** Giffard.
   Vertex only about two-thirds or less as broad across basal angles as breadth of an eye; tegmina milky hyaline.. .... **swezeyi** Giffard.

3(1). Costa of tegmina, as seen from side or above, strongly expanded toward base and there about three or four times as broad as at middle and strongly arched (fig. 34, d) .... **montanus** Giffard.
   Costa not so expanded, usually not much broader subbasally than at middle, never more than twice as broad and not strongly arched 4

4(3). Basal color of mesonotum brown 5
   Basal color of mesonotum black or nearly so 7

5(4). Lateral margin of front of head as viewed from side forming a very definite and conspicuous angle with sides of fossette; distance between eye and side of fossette greater than breadth of second antennal segment; a large species, 7.5–12.5 mm. in length .... **tamehameha** Kirkaldy.
   Lateral margin of front forming nearly an even curve with side of fossette and never so angulate as *tamehameha;* distance between an eye and side of fossette less than breadth of second antennal segment; length: 5.5–8.0 mm 6

6(5). A short, stumpy species with tegmina only about two and one-half times as long as broad; veins partly particolored, granules darker than veins and conspicuous.... .... **halemanu** Giffard.
   A comparatively slender species with tegmina about three times as long as broad or longer; tegmina conspicuously yellowish; veins pallid, not particolored, granules pale and inconspicuous .... **immaculatus** Giffard.

7(4). Mesonotal carinae largely pale .... **koae** Giffard.
   Mesonotal carinae mostly or entirely dark 8

8(7). Tegminal membrane immaculate, veins not or only slightly particolored 9
   Tegmina maculate, or veins particolored, or both 10

9(8). Lateral margins of fossette and vertex, as seen from side forming a very conspicuous nearly right angle; dis-

tance between an eye and above-mentioned angle greater than breadth of a second antennal segment......... ....**silvestris** Kirkaldy.

Lateral margins of fossette and vertex more nearly rounded into one another; distance between an eye and hind angle of fossette less than breadth of a second antennal segment..................**nubigenus** Kirkaldy.

10(8). About the basal third of tegminal membrane fuliginous ....**lihue** Giffard.

Tegminal membrane not so colored....................11

11(10). Tegminal veins conspicuously particolored, their granules mostly inconspicuous..................................12

Tegminal veins not or inconspicuously particolored, granules mostly conspicuous..............................13

12(11). Sides of vertex subparallel, hardly expanded caudad, extreme breadth between basal angles obviously much narrower than breadth of an eye.................. ....**consimilis** Giffard.

Sides of vertex obviously divergent caudad, distance across basal angles nearly, but not quite, as broad as an eye............................**intermedius** Giffard.

13(12). **O. kauaiensis** Kirkaldy and **waialeale** Giffard. I have been unable to find adequate characters to separate these supposed species on the basis of available material.

OAHU SPECIES

(Excepting *procellaris*)

1. Costa of tegmina, as seen from side or above, strongly expanded basad and there about three or four times as broad as at middle (fig. 34, d)...........**olympus** Giffard.

Costa not so expanded, usually not much broader subbasally than at middle, never more than twice as broad... 2

2(1). Vertex unusually broad and short, breadth across basal angles much greater than breadth of an eye, nearly twice as broad; a peculiar small (4.5 mm.), stubby, lowland species with a predominantly pale mesonotum ....**discrepans** Giffard.

Not such species.................................... 3

3(2). Basal color of mesonotum brown or pale brown, or keels pale or both..................................... 4

Basal color of mesonotum, including keels, black or nearly so.......................................15

4(3). Tegmina and wings appearing unusually and conspicuously milky white to the unaided eyes, without numerous maculae and veins pallid except at apex..... ....**albatus** Giffard.

Not such white species, tegmina either hyaline, milky hyaline or maculate or both, but never unusually white.. 5

5(4). Fossette of vertex appearing conspicuously transverse, or the depression continuous transversely and median line not elevated except at base to divide fossette into two areolets, or both 6
Fossette of vertex with median line elevated to a greater or lesser extent and dividing or partially dividing fossette into two areolets 7
6(5). Tegmina maculate .... **acaciae** Kirkaldy.
Tegmina not maculate .... **instabilis** Giffard.
7(5). Tegminal veins particolored but mostly conspicuously dark brown and outstanding over most of tegmina 8
Tegminal veins particolored or not, but mostly pale or pale brown, never dark and prominent over most of wing 10
8(7). Median line of fossette of vertex distinct only at base and not separating areolets which are thus broadly coalescent .... **kaohinani** Kirkaldy.
Median line of fossette swollen and elevated throughout nearly all of its length thus separating areolets 9
9(8). Fossette dark, V-shaped anteriorly .... **likelike** Giffard.
Fossette apically rounded or subtruncate, usually mostly pale .... **pele** Kirkaldy.
10(7). Vertex comparatively narrow, median length about two and one-half times as long as broad across basal angles from a line drawn between basal angles to base of fossette 11
Vertex less than or hardly more than twice as long as broad across basal angles 12
11(10). Tegminal veins particolored .... **kaumuahona** Giffard.
Tegminal veins not particolored .... **wailupensis** Giffard.
(Note: I am not satisfied that these names represent two distinct species.)
12(10). Foveate or depressed area at top of median facial carina and between its divergent arms well removed from level of areolets of fossette .... **kirkaldyi** Giffard.
This foveate area closely approaching level of areolets of fossette, at most only shortly separated from level of areolets 13
13(12). Tegmina milky .... **myoporicola** Giffard.
Tegmina hyaline or yellowish hyaline, not milky 14
14(13). Cross-veins of apical parts of tegmina distinctly suffused: face with pale maculae at sides .... **makaala** Giffard.
Cross-veins not suffused; face without pale maculae at sides .... **kaonohi** Kirkaldy.
15(3). Basal and apical thirds of tegmina conspicuously fuliginous, middle third mostly hyaline, colored zones conspicuous to unaided eyes 16
Tegmina without three color zones 17
16(15). The fuliginous color on tegmina broadly, conspicuously extending entirely along claval area, thus joining basal and apical fuliginous areas .... **neotarai** Giffard.

The fuliginous color on tegmina not extending along claval area at middle, or only indistinctly so, and not connecting basal and apical fuliginous areas......... ....**tarai** Kirkaldy.

17(15). Tegminal veins particolored..............**kaiulani** Giffard.
Tegminal veins not particolored...........**tantalus** Giffard.

MOLOKAI SPECIES

(Excepting *paludicola,* but see figure 35, e, f)

1. Vertex very broad, broader across basal angles than breadth of an eye, and about as broad as long; tegmina in part or largely fuliginous......................... 2
Vertex narrower, longer than broad, tegmina not fuliginous...3

2(1). Tegmina entirely dark fuliginous, veins dark......... ....**morai** (Kirkaldy).
Tegmina mostly pale fuliginous, veins mostly pale..... ....**neomorai** Giffard.

3(1). Tegmina clear, veins particolored, membrane maculate ....**kahavalu** Kirkaldy.
Tegmina yellowish hyaline, veins not particolored, membrane immaculate in basal two-thirds at least....... ....**similis** Giffard.

LANAI SPECIES

1. Costa broadly expanded and strongly curved basad (fig. 34, d), three or more times as broad subbasally as near stigma............................**hevaheva** Kirkaldy.
Costa not so broadened and strongly arched basad, at most twice as broad subbasally as near stigma......... 2

2(1). Mesonotum broad or pale; rather small slender species ....**koele** Giffard.
Mesonotum black; medium-sized, broad species.......... 3

3(2). Tegmina clear, veins particolored, membrane maculate ....**kahavalu** Kirkaldy.
Tegmina yellowish hyaline, veins not particolored, membrane immaculate in basal two-thirds at least......... ....**similis** Giffard.

MAUI SPECIES

(Excepting *monticola*)

1. Tegmina fuliginous at base and apex, hyaline in middle section, thus with three conspicuous color zones..... ....**tarai** Kirkaldy.
Tegmina without three such colored bands............... 2

2(1). Costa strongly convex in longitudinal outline basad, and thickened and three times as broad near base as nar-

rowest breadth before stigma (a large species with tegmina largely yellowish, but fuliginous on about apical third)............................**mauiensis** Giffard.

Costa not so expanded and arched, not more than twice as broad subbasally as before stigma and more flatly arcuate than arched basad (some species have costa expanded basad, but not so much as in *mauiensis* and without such colored tegmina in combination with a much-thickened costa).............................. 3

3(2). Mesonotum and keels black........................... 4

Mesonotum and/or keels pale or brown................ 6

4(3). Tegminal membrane conspicuously spotted; veins conspicuously particolored (a large spotted species)..... ....**kulanus** Giffard.

Tegminal membrane inconspicuously spotted or immaculate in basal two-thirds; veins not particolored......... 5

5(4). Length about 9 mm. or more; rostrum surpassing hind coxae for a distance about as great as length of an eye ....**haleakalae** Kirkaldy.

Length not over 8 mm.; rostrum extending but little behind hind coxae.......................**similis** Giffard.

6(3). Tegminal membrane spotted, costal cell spotted........ ....**euphorbiae** Giffard.

Tegminal membrane not spotted in basal two-thirds, costal cell not spotted.............................. 7

7(6). Wings appearing opaque white through tegmina...... ....**halehaku** Giffard.

Wings clear............................**pele** Kirkaldy.

HAWAII SPECIES

(Excepting *nemoricola*, but see figure 35, a, b)

1. Tegmina fuliginous at base and apex, hyaline between, thus with three colored zones.............**tarai** Kirkaldy.

Tegmina not so colored............................. 2

2(1). Costa three times as broad near base as at its narrowest point near stigma..................**hevaheva** Kirkaldy.

Costa not more than twice as broad subbasally as near stigma.. 3

3(2). Fossette of vertex with median line for most part or entirely swollen or cariniform and dividing fossette into two areolets, fossette never continuously and evenly excavate transversely............................. 4

Fossette of vertex nearly or quite continuously excavate transversely and with median line traceable only shortly at base, fossette usually, not always, transverse, sometimes strongly so................................. 5

4(3). Areolet-like depression between basal arms of median carina of frons large, about twice as long as median line of fossette.....................**filicicola** Kirkaldy.

The above-described depression much smaller, more nearly size of an areolet of fossette and not much longer than median line of fossette, area between areolets and arms of median carina of frons tumescent and carinae coalescent.........................**koanoa** Kirkaldy.

5(3). Keels of mesonotum pale; vertex unusually broad...**opuna** Kirkaldy.

Keels of mesonotum dark; vertex not unusually broad.... 6

6(5). Veins of tegmina mostly uniformly dark overall; membrane whitish............................**niger** Giffard.

Veins particolored, partly pale or mostly pale, never dark overall.. 7

7(6). Veins over basal two-thirds of tegmina all pale, yellowish, membrane immaculate................**inaequalis** Giffard.

Veins at least partially particolored; membrane maculate or not.. 8

8(7). Length 8–9 mm.; veins mostly conspicuously dark, particoloration sharply marked, membrane usually conspicuously maculate...................**kanakanus** Kirkaldy.

Length 6–7.5 mm.; veins mostly pale, particoloration feeble, maculae of membrane pale if present...**inconstans** Giffard.

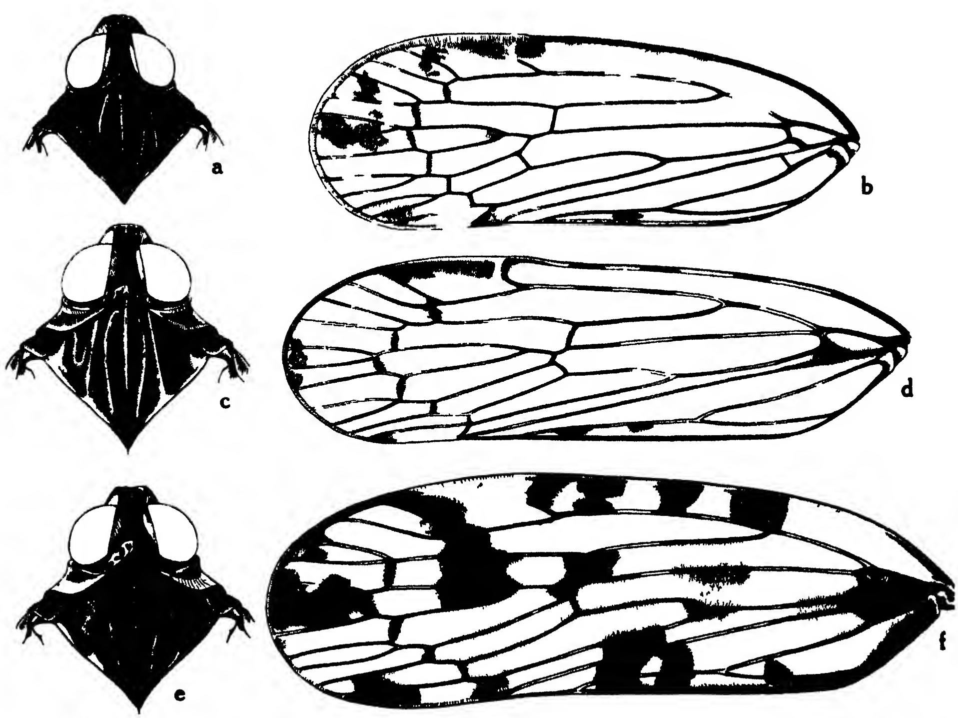

Figure 35—Holotypes of some *Oliarus*: **a, b,** *O. nemoricola* Kirkaldy; **c, d,** *O. pluvialis* Kirkaldy; **e, f,** *O. paludicola* Kirkaldy. (Drawn at the British Museum of Natural History by Smith. The tegmina are not drawn to same scale as the head figures.)

Oliarus acaciae Kirkaldy (figs. 32, C; 36).
Oliarus acaciae Kirkaldy, 1909:78. Giffard, 1925:129, pl. 1, fig. 9; pl. 2, fig. 14.

Endemic. Oahu (type locality: Mount Kaala, 3,500 feet).
Hostplant: *Acacia koa.*
This species is a close ally of *euphorbiae, opuna* and *koae.*

Oliarus albatus Giffard (fig. 36).
Oliarus albatus Giffard, 1925:135, pl. 6, figs. 104, 105.

Endemic. Oahu (type locality: Hillebrand Glen, Nuuanu Valley, Honolulu).
The unusually milky tegmina are distinctive.

Oliarus consimilis Giffard (fig. 36).
Oliarus consimilis Giffard, 1925:123, pl. 7, figs. 123, 124.

Endemic. Kauai (type locality: "lower forest above Lihue, at 800 feet elevation").

Oliarus discrepans Giffard (figs. 34, g, r; 36).
Oliarus discrepans Giffard, 1925:79, pl. 3, figs. 41, 48.

Endemic. Oahu (type locality: Ewa Mill).
Hostplant: *Gossypium tomentosum.*
This is a peculiar little species. It so differs from the other Hawaiian *Oliarus* that Giffard thought that it might possibly prove to be an immigrant. However, it appears more likely that it is a remnant of the now nearly extinct lowland fauna of Oahu. I have collected usually single specimens here and there about Honolulu and elsewhere in the lowlands. Most of the examples taken by me were seen sitting on the sides of buildings or on posts or have been swept from vegetation. A specimen flew onto my desk at the Bishop Museum while I was writing this volume. Dr. Swezey has taken series of examples from the native cotton, *Gossypium tomentosum,* and has found the nymphs and adults under stones. Giffard did not know the males, but male examples are now in our collections.

Oliarus euphorbiae Giffard (figs. 32, A; 36).
Oliarus euphorbiae Giffard, 1925:128, pl. 2, fig. 16; pl. 6, fig. 102.

Endemic. Maui (type locality: Iao Valley).
Hostplant: *Euphorbia.*

Figure 36—*Oliarus* species. Top row, left to right: *O. acaciae* Kirkaldy, paratype female; *O. albatus* Giffard, paratype male; *O. consimilis* Giffard, paratype male. Bottom row, left to right: *O. discrepans* Giffard, paratype female; *O. euphorbiae* Giffard, paratype male; *O. filicicola* Giffard, paratype male.

Oliarus filicicola Kirkaldy (figs. 34, m; 36).

Oliarus filicicola Kirkaldy, 1909:77. Giffard, 1925:88, pl. 4, figs. 63, 64; pl. 8, fig. 140.

Oliarus montivagus Kirkaldy, 1909:78; synonymy by Giffard, 1925:88.

Oliarus kaonohi variety *volcanicola* Kirkaldy, 1909:78, footnote; synonymy by Giffard, 1925:88.

Endemic. Hawaii (type locality: Naalehu).

Hostplant: *Cibotium* tree ferns (nymphs found amongst decaying fronds).

Oliarus haleakalae Kirkaldy (fig. 37).

Oliarus haleakalae Kirkaldy, 1909:78.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplants: *Cibotium chamissoi* (tree fern), *Cyrtandra*.

Oliarus halehaku Giffard (fig. 37).

Oliarus halehaku Giffard, 1925:94, pl. 4, figs. 68, 69.

Endemic. Maui (type locality: Nahiku).

Hostplants: *Cibotium, Sadleria,* rotten tree fern fronds, *Pipturus*.

It may be that this is really *kaonohi*.

Oliarus halemanu Giffard.

Oliarus halemanu Giffard, 1925:133, pl. 6, figs. 99, 100.

Endemic. Kauai (type locality: Halemanu).

Oliarus hevaheva Kirkaldy (figs. 33, e; 34, d; 37).

Oliarus hevaheva Kirkaldy, 1902:122, pl. 4, fig. 6. Giffard, 1925:104, pl. 1, fig. 5; pl. 5, figs. 84, 85.

Oliarus lanaiensis Giffard, 1925:106, pl. 5, figs. 80, 81 (type locality: Lanai, 2,000 feet). New synonym.

Endemic. Lanai, Hawaii (type locality: Kona).

There are several species which have the costa distinctly expanded basad which are associated with this form. The drawings illustrate the character. I cannot accept Giffard's *lanaiensis,* for I can find no reason to separate his holotype from typical *hevaheva*.

Oliarus immaculatus Giffard (figs. 33, d; 37).

Oliarus immaculatus Giffard, 1925:96, pl. 1, fig. 4; pl. 4, figs. 60, 65; pl. 6, fig. 106.

Figure 37—*Oliarus* species Top row, left to right: *O. halcakalae* Kirkaldy, male; *O. halehaku* Giffard, paratype male; *O. halehaku* Giffard, paratype female. Bottom row, left to right: *O. hevaheva* Kirkaldy, male; *O. inaequalis* Giffard, paratype male; *O. immaculatus* Giffard, paratype male.

Endemic. Kauai (type locality: Kokee).
Hostplants: "ferns."

Oliarus inaequalis Giffard (fig. 37).
Oliarus inaequalis Giffard, 1925:136, pl. 6, figs. 110, 111.

Endemic. Hawaii (type locality: South Kona Road, 1,600 feet).
This species is closely allied to, and forms a group with, *similis, instabilis* and *inconstans*. The group may be a species or a "superspecies." The typical form has pale, yellowish-clouded, immaculate tegmina. Giffard noted (1925:139) that "There is apparently but little difference in the structure or characters of the aedeagus of this species and of its varieties, and these indicate very close affinities to *similis* of Maui, as well as *inconstans* of Hawaii. Both of these species are undoubtedly extreme forms of *inaequalis*."

Oliarus inaequalis koebelei Metcalf.
Oliarus inaequalis variety *b* Giffard, 1925:137.
Oliarus inaequalis variety *koebelei* Metcalf, 1936:69.

Endemic. Hawaii (type locality: above Dowsett Ranch, Kona, 7,000 feet).

Oliarus inaequalis kohala Metcalf.
Oliarus inaequalis variety *c* Giffard, 1925:138.
Oliarus inaequalis variety *kohala* Metcalf, 1936:69.

Endemic. Hawaii (type locality: Upper Hamakua Ditch Trail, Kohala Mountains).

Oliarus inaequalis konana Metcalf.
Oliarus inaequalis variety *a* Giffard, 1925:137.
Oliarus inaequalis variety *konana* Metcalf, 1936:69.

Endemic. Hawaii (type locality: Puuwaawaa, North Kona, 3,800 feet).

Oliarus inconstans Giffard (fig. 38).
Oliarus inconstans Giffard, 1925:145, pl. 8, figs. 132, 133.

Endemic. Hawaii (type locality: Kilauea).
Giffard noted varieties with maculate and immaculate tegmina, and said (p. 147) "The aedeagus indicates that this species is merely another form of *inaequalis* and its insular allies, and is equally as variable as these."

Oliarus instabilis Giffard (figs. 34, h; 38).

Oliarus instabilis Giffard, 1925:142, pl. 8, figs. 129–131, 137.

Endemic. Oahu (type locality: Wailupe).

Giffard (p. 145) noted that "This is a very variable species and no doubt represents the Oahu form of what I have called the *'inaequalis–similis'* group from Hawaii and Maui. As in that group, the structure and colorations are very unstable, the sexual dimorphism confusing, and the characters of the genitalia in a marked degree variable. Of the seven dissections made of the aedeagus, no two are quite alike as to the structural outline of the apical third of the periandrium, but all have a similarity in one aspect or another."

Although Giffard designated and labeled types of his varieties of *inaequalis,* he neglected to do so for the varieties of this species. His material of the following varieties bears no type labels, but one example of each form bears a label on which the sex and the variety name are written in red ink. I have used the localities of these forms as the typical localities.

Oliarus instabilis bryani Metcalf.

Oliarus instabilis variety *a* Giffard, 1925:143.

Oliarus instabilis variety *bryani* Metcalf, 1936:70.

Endemic. Oahu (type locality: Mount Kaala).

Oliarus instabilis crawi Metcalf.

Oliarus instabilis variety *b* Giffard, 1925:144.

Oliarus instabilis variety *crawi* Metcalf, 1936:70.

Endemic. Oahu (type locality: Mount Olympus).

Oliarus instabilis ehrhorni Metcalf.

Oliarus instabilis variety *c* Giffard, 1925:144.

Oliarus instabilis variety *ehrhorni* Metcalf, 1936:70.

Endemic. Oahu (type locality: Mount Kaala).

Oliarus instabilis osborni Metcalf.

Oliarus instabilis variety *d* Giffard, 1925:144.

Oliarus instabilis variety *osborni* Metcalf, 1936:70.

Endemic. Oahu (type locality: Waialae Nui).

Oliarus instabilis terryi Metcalf.

Oliarus instabilis variety *e* Giffard, 1925:144.
Oliarus instabilis variety *terryi* Metcalf, 1936:70.

Endemic. Oahu (type locality: Mount Kaala).

Oliarus instabilis williamsi Metcalf.

Oliarus instabilis variety *f* Giffard, 1925:144.
Oliarus instabilis variety *williamsi* Metcalf, 1936:70.

Endemic. Oahu (type locality: Punaluu).

Oliarus intermedius Giffard (fig. 38).

Oliarus intermedius Giffard, 1925:122, pl. 7, figs. 121, 126.

Endemic. Kauai (type locality: Kaholuamano).
This is perhaps a representative of the Oahu *kaohinani*.

Oliarus kahavalu Kirkaldy (fig. 38).

Oliarus kahavalu Kirkaldy, 1909:77. Giffard, 1925:116, pl. 7, figs. 116, 117.

Endemic. Molokai (type locality: 4,000 feet), Maui.
Hostplant: *Metrosideros*.
This is an ally of *kanakanus* from Hawaii.

Oliarus kaiulani Giffard (fig. 38).

Oliarus kaiulani Giffard, 1925:69, pl. 3, figs. 27–30.

Endemic. Oahu (type locality: Halawa).

Oliarus kanakanus Kirkaldy (fig. 38).

Oliarus kanakanus Kirkaldy, 1902:121, pl. 4, fig. 5. Giffard, 1925:113, pl. 7, figs. 114, 115.

Endemic. Hawaii (type locality: Kilauea).
Hostplant: *Metrosideros*.
The specimens from Maui and Oahu referred to this species by Kirkaldy in his original description belong to other species, as Giffard has shown.

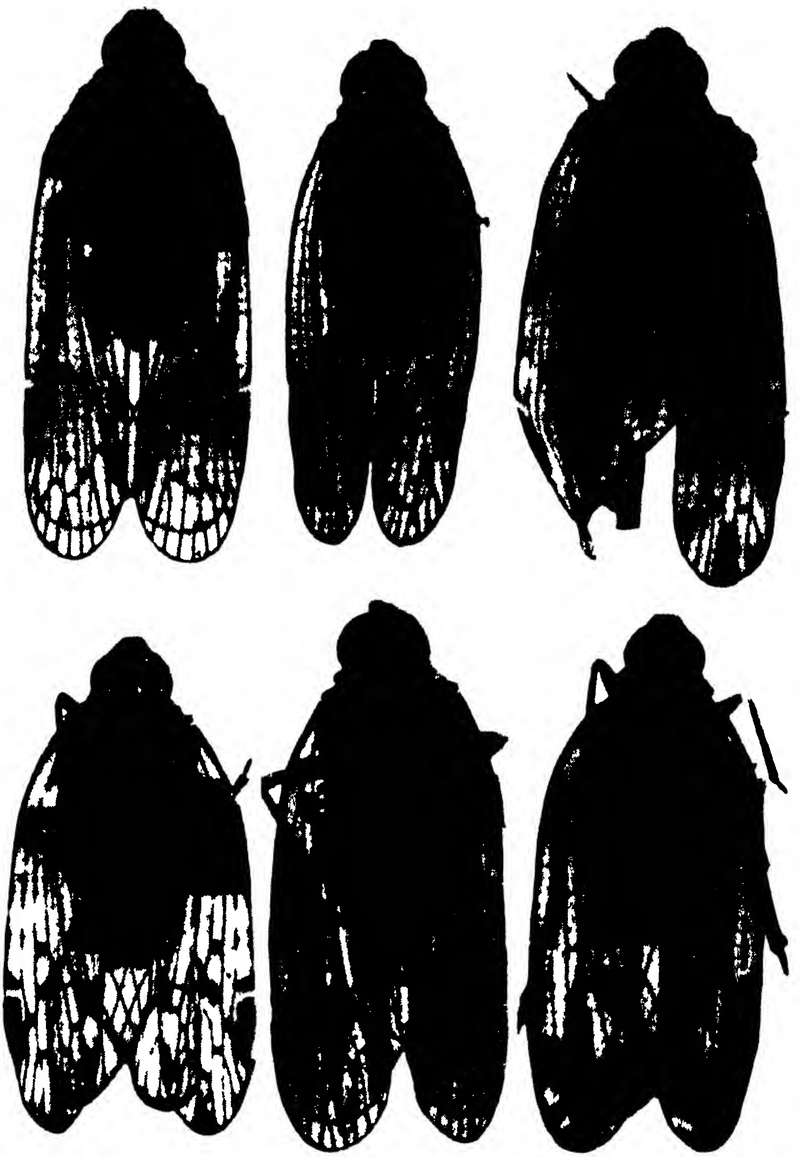

Figure 38—*Oliarus* species Top row, left to right: *O. inconstans* Giffard, paratype female; *O. instabilis* Giffard, paratype male; *O. intermedius* Giffard, paratype male. Bottom row, left to right: *O. kahavalu* Kirkaldy, male; *O. kaiulani* Giffard, paratype male; *O. kanakanus* Kirkaldy, male.

Oliarus kanakanus punaensis Metcalf.

Oliarus kanakanus variety *a* Giffard, 1925:114.

Oliarus kanakanus variety *punaensis* Metcalf, 1936:71.

Endemic. Hawaii (type locality: Puna, 750 feet).

Oliarus kaohinani Kirkaldy (fig. 39).

Oliarus kaohinani Kirkaldy, 1909:78. Giffard, 1925:119, pl. 7, figs. 119, 120.

Endemic. Oahu (type locality: Mount Tantalus).

Oliarus kaohinani perkinsi Metcalf.

Oliarus kaohinani variety Giffard, 1925:120.

Oliarus kaohinani variety *perkinsi* Metcalf, 1936:71.

Endemic. Oahu.

Although Metcalf stated that Giffard had called this form "var. *a*," Giffard simply labeled it "var.," and did not further designate it. Giffard also listed specimens under the following subtitles: "Varieties with tegmina almost immaculate" and "Varieties with tegmina maculate."

Oliarus kaonohi Kirkaldy (fig. 39).

Oliarus kaonohi Kirkaldy, 1909:77; Giffard, 1925:91, pl. 4, figs. 61, 62.

Oliarus silvicola Kirkaldy, 1909:78 (type from Konahuanui, Oahu). Synonymy by Giffard, 1925:91.

Endemic. Oahu (type locality: "Honolulu").

Hostplants: *Broussaisia,* rotting tree fern fronds.

Kirkaldy's Hawaii record of this species applies to another.

This is an ally of *morai*. Giffard said (p. 93) that "It is suspiciously evident that either both forms are the result of cross-breeding, or that one of these is still evolving from the other."

Oliarus kauaiensis Kirkaldy (figs. 34, e; 39).

Oliarus kauaiensis Kirkaldy, 1909:79. Giffard, 1925:123, pl. 6, figs. 90, 91.

Endemic. Kauai (lectotype locality: lower forest, near Lihue, 800 feet).

The holotype is presumed to be lost, and Giffard selected male and female lectotypes.

Figure 39—*Oliarus* species. *O. kaonohi* Kirkaldy, female, top; *O. kaohinani* Kirkaldy, male, left; *O. kauaiensis* Kirkaldy, male, center; *O. kaumuahona* Giffard, paratype male, right.

Oliarus kaumuahona Giffard (fig. 39).
Oliarus kaumuahona Giffard, 1925:77, pl. 3, figs. 42, 43.

Endemic. Oahu (type locality: Kaumuahona).
This is a close ally of *wailupensis*, and I am not sure that it is not the same species.

Oliarus kirkaldyi Giffard (figs. 34, q; 40).
Oliarus kirkaldyi Giffard, 1925:77, pl. 3, figs. 31, 36, 45–47, 49.

Endemic. Oahu (type locality: Waianae).

Oliarus koae Giffard.

Oliarus koae Giffard, 1925:130, pl. 6, fig. 103.

Endemic. Kauai (type locality: Halemanu).

Hostplant: *Acacia koa.*

This belongs in association with *acaciae, euphorbiae* and *opuna,* and Giffard noted that it is "one extreme and *opuna* of Hawaii the other in this particular group, the intermediates being *euphorbiae* of Maui and *acaciae* of Oahu."

Oliarus koanoa Kirkaldy (figs. 33, b; 40).

Oliarus koanoa Kirkaldy, 1902:124, pl. 4, fig. 11. Giffard, 1925:72, pl. 1, fig. 2; pl. 3, figs. 34, 35.

Endemic. Hawaii (type locality: Kona).

Hostplants: *Maba sandwicensis,* tree fern.

Perhaps if Giffard had not had such a large series of this variable species before him he would have given letters of designation to various of the varietal forms. But his series was extensive enough to include intergrades, and he said (p. 74), "It would be impossible to discriminate between all these variations, because of slight differences in size and color without even larger series of each than those studied, and, so long as the structures [of the genitalia] of all are alike, it is well to lump them and save confusion."

Swezey (1907:83–84) recorded his observations on the biology of this species, and his remarks are included here in the introductory notes to this family.

Oliarus koele Giffard (figs. 34, c, n; 40).

Oliarus koele Giffard, 1925:93, pl. 4, figs. 70, 71.

Oliarus agnatus Giffard, 1925:134, pl. 6, figs. 107, 108; pl. 8, fig. 139 (type locality: Lanai, 3,000 feet). New synonym.

Endemic. Lanai (type locality: 3,000 feet).

Hostplant: ferns.

This is the Lanai representative of *kaonohi,* and closer study may show that it is identical to *kaonohi;* but as Giffard's drawings of the male genitalia show differences, I do not feel qualified to synonymize the species at this time.

Although Giffard placed *agnatus* in division E and *koele* in division C, I find from a study of the types that the two names apply to only one species. *O. agnatus* is represented by the male holotype and one male paratype. I cannot understand why Giffard separated the two forms when the holotypes so closely resemble each other, or why he did not draw some attention to this fact in his text.

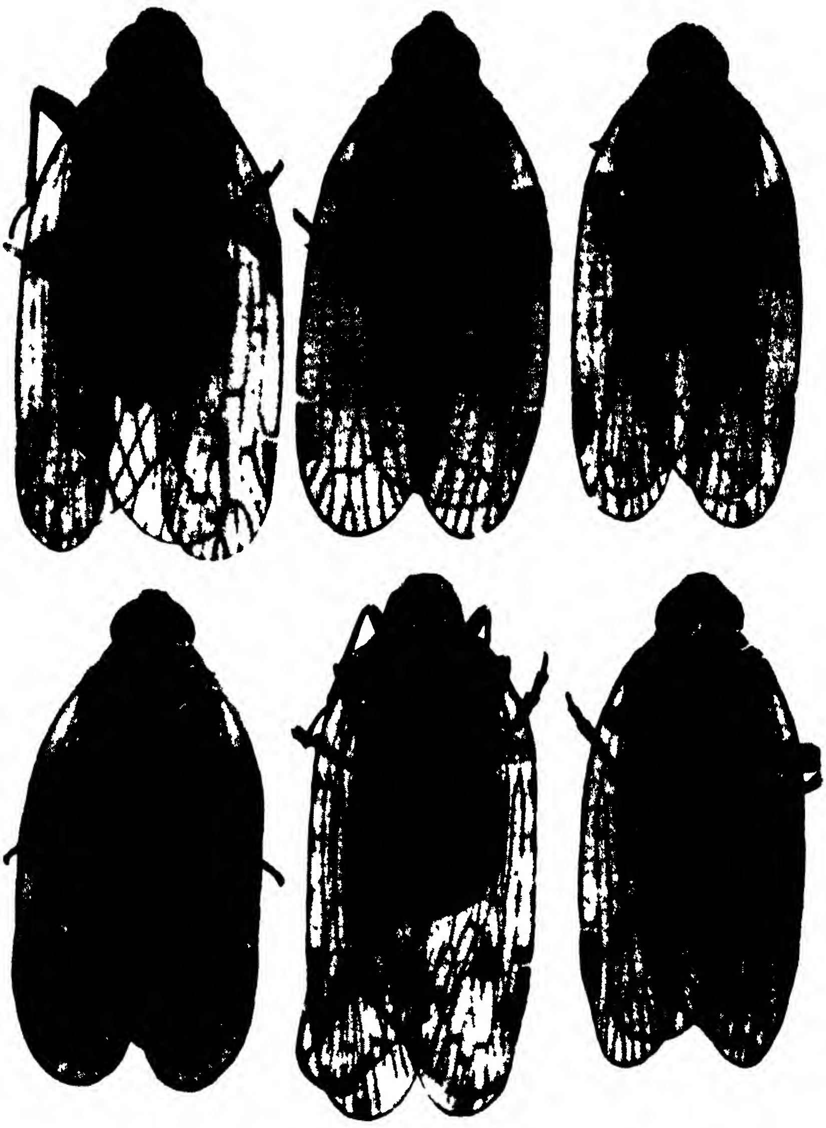

Figure 40—*Oliarus* species. Top row, left to right *O kirkaldyi* Giffard, paratype female; *O koanoa* Kirkaldy, male; *O. koanoa* Kirkaldy, female Bottom row, left to right: *O. koele* Giffard, paratype male; *O. kulanus* Giffard, paratype female; *O. likolike* Giffard, paratype male.

Oliarus kulanus Giffard (figs. 33, f: 40).
Oliarus kulanus Giffard, 1925:117, pl. 1, fig. 6.

Endemic. Maui (type locality: Haleakala, 5,000–5,300 feet).
This species is an associate of *kahavalu* in the *kanakanus* group.

Oliarus lihue Giffard.
Oliarus lihue Giffard, 1925:125, pl. 6, figs. 94, 95.

Endemic. Kauai (type locality: near Lihue, 800 feet).

Oliarus likelike Giffard (fig. 40).
Oliarus likelike Giffard, 1925:86, pl. 4, figs. 58, 59.

Endemic. Oahu (type locality: Konahuanui).
This is a close ally of *pele,* and I am not sure that it is specifically distinct.

Oliarus makaala Giffard (fig. 41).
Oliarus makaala Giffard, 1925:87, pl. 4, figs. 54, 55.

Endemic. Oahu (type locality: Mount Kaala).
This species is allied to *likelike* and *pele.*

Oliarus mauiensis Giffard.
Oliarus mauiensis Giffard, 1925:109, pl. 7, figs. 112, 113.

Endemic. Maui (type locality: Waihee Valley).
This is a member of the *hevaheva* group.

Oliarus montanus Giffard (fig. 41).
Oliarus montanus Giffard, 1925:111, pl. 5, figs. 86, 87; pl. 8, fig. 125.

Endemic. Kauai (type locality: Olokele Canyon).
Giffard considered this to be an "intermediate form" between the *hevaheva* and *kanakanus* groups.

Oliarus monticola Kirkaldy.
Oliarus monticola Kirkaldy, 1909:78. Giffard, 1925:148.

Endemic. Maui (type locality: Haleakala, 5,000 feet).
The single male type is in the British Museum, but Giffard was unable to recognize the species in the material studied by him.

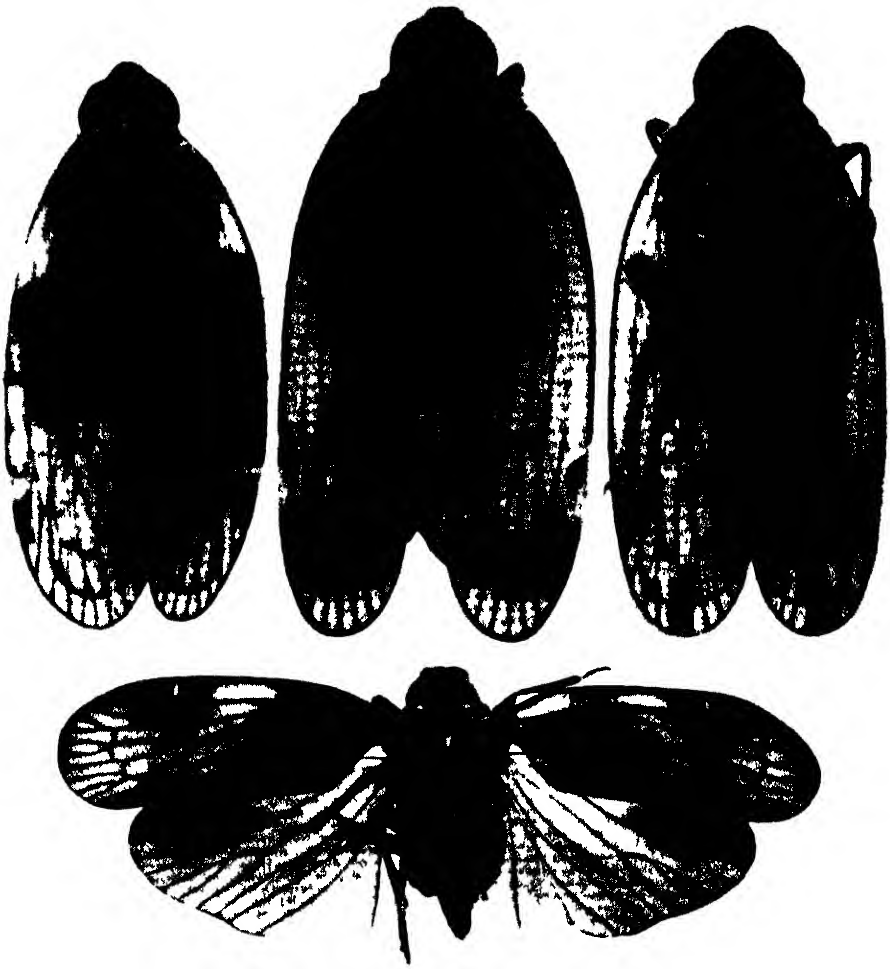

Figure 41—*Oliarus* species *O. makaala* Giffard, paratype male, left; *O. montanus* Giffard, male, center, *O myoporicola* Giffard, paratype female, right, *O morai* Kirkaldy, male, bottom.

Oliarus morai (Kirkaldy) (fig. 41).

Oliarus tarai variety *morai* Kirkaldy, 1902:123.

Oliarus morai (Kirkaldy) Kirkaldy, 1908:201, pl. 4, fig. 9. Giffard, 1925:101, pl. 5, figs. 76, 77.

Endemic. Molokai (type locality: 4,000 feet).

This is a close ally of *tarai,* and Giffard considered it to be "one of the transitional forms of *kaonohi.*" It does not occur on Maui as recorded by Kirkaldy.

Oliarus muiri Giffard (fig. 34, k).
Oliarus muiri Giffard, 1925:66, pl. 2, figs. 19–21.

Endemic. Kauai (type locality: Alakai Swamp).
Giffard (p. 67) noted that "This unique species and the one following (*swezeyi*) are evidently the closest relatives, so far known, of the ancestral form from which all the Hawaiian species have descended. The structure of the vertex, particularly, presents the strongest evidence that it is congeneric with the genotype *Oliarus walkeri* Stål. The aedeagus of this and the following species (*swezeyi*) is quite unlike that of any other Hawaiian forms."

Oliarus myoporicola Giffard (fig. 41).
Oliarus myoporicola Giffard, 1925:74, pl. 1, figs. 12, 13; pl. 3, figs. 37, 38, 44.

Endemic. Oahu (type locality: Barber's Point).
Hostplant: *Myoporum sandwicense*.
This is one of the few existing lowland *Oliarus*.

Oliarus neomorai Giffard (fig. 42).
Oliarus neomorai Giffard, 1925:102.

Endemic. Molokai (type locality: Kalae).
This form is closely allied to *morai* and may not be specifically distinct.

Oliarus neomorai oahuana Metcalf.
Oliarus neomorai variety *a* Giffard, 1925:103.
Oliarus neomorai variety *oahuana* Metcalf, 1936:85.

Endemic. Oahu, Hawaii (?).
The status of this form is questionable.

Oliarus nemoricola Kirkaldy (fig. 35, a, b).
Oliarus nemoricola Kirkaldy, 1909:79. Giffard, 1925:148.

Endemic. Hawaii (type locality: Hilo, 2,000 feet).
The male type (figured here) is in the British Museum, and the species was not recognized by Giffard, who considered it to be possibly "one of the varietal forms of either the *kanakanus* or *hevaheva* groups."

Oliarus neotarai Giffard (fig. 42).
Oliarus neotarai Giffard, 1925:99, pl. 4, figs. 66, 67.

Endemic. Oahu (type locality: Lanihuli).
This species is allied to *tarai*.

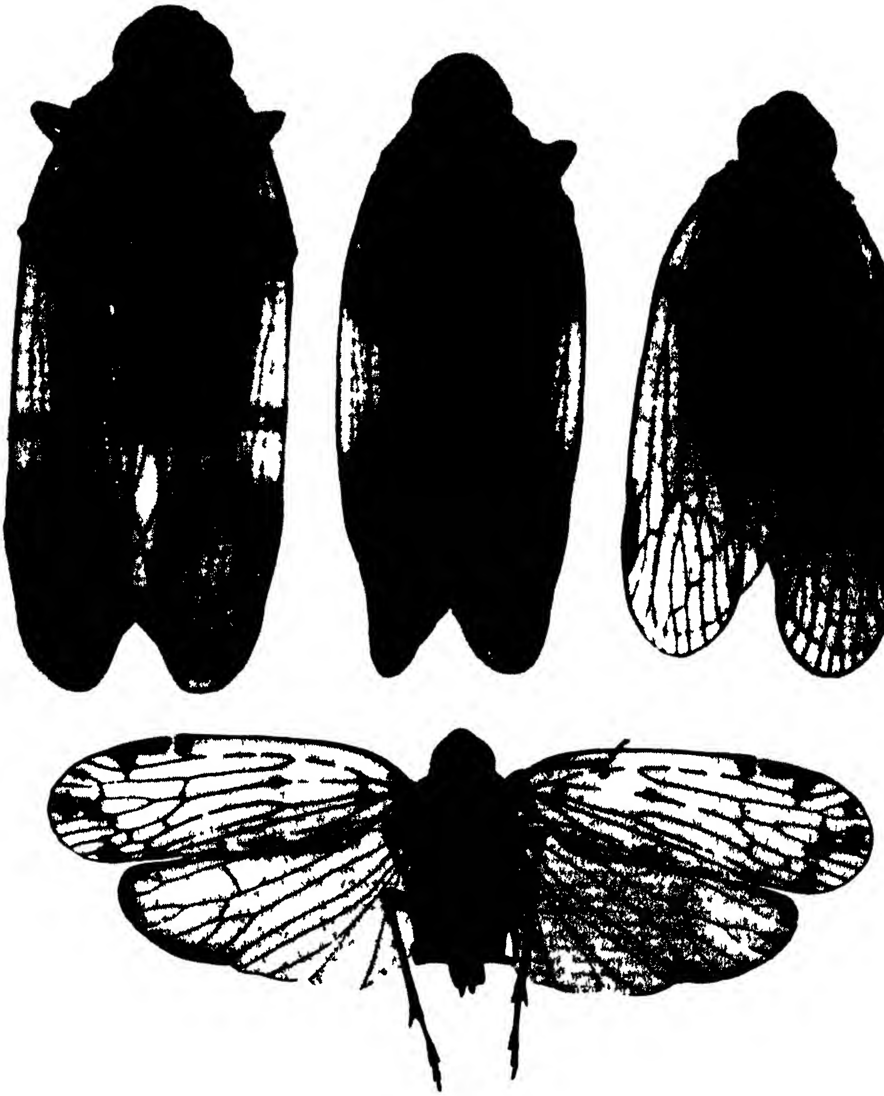

Figure 42—*Oliarus* species *O neomorai* Giffard, female, left, *O neotarai* Giffard, paratype male, center, *O niger* Giffard, paratype female, right, *O olympus* Giffard, paratype female, bottom

Oliarus niger Giffard (figs. 34, f; 42).
Oliarus niger Giffard, 1925:131, pl 6, figs 88, 89, 96.

Endemic. Hawaii (type locality: South Kona Road, 1,900 feet).

Oliarus nubigenus Kirkaldy (figs. 33, c; 43).
Oliarus nubigenus Kirkaldy, 1909:78. Giffard, 1925:82, pl. 1, figs. 3, 8; pl. 4, figs. 52, 53.

Endemic. Kauai (type locality: Halemanu, 4,000 feet).

Oliarus olympus Giffard (figs. 34, i; 42).
Oliarus olympus Giffard, 1925:106, pl. 5, figs. 78, 79; pl. 6, fig. 109.

Endemic. Oahu (type locality: Kuliouou).
Hostplant: *Metrosideros*.
This is another of the *hevaheva* group.

Oliarus olympus paliensis Metcalf.
Oliarus olympus variety *a* Giffard, 1925:108.
Oliarus olympus variety *paliensis* Metcalf, 1936:87.

Endemic. Oahu.
Giffard selected no type for this form, and I doubt that it should be named.

Oliarus opuna Kirkaldy (fig. 43).
Oliarus opuna Kirkaldy, 1902:122, pl. 4, fig. 7. Giffard, 1925:127, pl. 1, fig. 10.
Oliarus puna Kirkaldy, 1909:79, typographical error.

Endemic. Hawaii (type locality: Kilauea).
Hostplants: *Astelia, Dubautia, Nephrolepis exaltata*.
This species belongs to the *acaciae–euphorbiae–koae* association.

Oliarus orono Kirkaldy.
Oliarus orono Kirkaldy, 1902:124, pl. 4, fig. 10. Giffard, 1925:148.

Endemic. Kauai (type locality: 4,000 feet).
This is one of the species which Giffard could not recognize from Kirkaldy's description and which remains unknown to us, as do the following "varieties." I have received a note from the British Museum stating that the type is in the Cambridge Museum.

Oliarus orono molokaiensis Kirkaldy.
Oliarus orono variety *molokaiensis* Kirkaldy, 1909:79. Giffard, 1925:149.

Endemic. Molokai.

Oliarus orono oahuensis Kirkaldy.

Oliarus orono variety *oahuensis* Kirkaldy, 1909:79. Giffard, 1925:149.

Endemic. Oahu.

It is doubtful that either of the above two "varieties" is correctly associated.

Oliarus paludicola Kirkaldy (figs. 35, e, f).

Oliarus paludicola Kirkaldy, 1909:79. Giffard, 1925:148.

Endemic. Molokai (type locality).

This form was unknown to Giffard, who thought that it might represent the Molokai form of *haleakalae*. The type is in the British Museum and is illustrated herein.

Oliarus pele Kirkaldy (fig. 43).

Oliarus pele Kirkaldy, 1909:79. Giffard, 1925:83, pl. 4, figs. 56, 57.

Endemic. Oahu (type locality unknown to me).

Hostplants: tree ferns; nymphs found in the soil about the fern roots, and Swezey reared specimens from nymphs found in rotting *Metrosideros* wood; adults have been taken from ferns and moss.

There is considerable confusion regarding this species. Kirkaldy's original series contained several species from several islands. Giffard limited it to Oahu. However, from the original description it would appear that Kirkaldy's type, if he designated one, should be a Kilauea, Hawaii, example. The name *pele* would thus apply to a different form than that selected by Giffard. The problem needs detailed study.

Oliarus pele alpha Metcalf.

Oliarus pele variety *a* Giffard, 1925:84.

Oliarus pele variety *alpha* Metcalf, 1936:95.

Endemic. Maui. No type was selected, but the typical male is from Keanae.

Oliarus pele beta Metcalf.

Oliarus pele variety *b* Giffard, 1925:85.

Oliarus pele variety *beta* Metcalf, 1936:95.

Endemic. Oahu. No type was designated, but the typical male is from Punaluu.

Oliarus pluvialis Kirkaldy (figs. 35, c, d).
Oliarus pluvialis Kirkaldy, 1909:78. Giffard, 1925:147.

Endemic. Kauai (type locality: Makaweli).
This species was not known to Giffard, and no named examples are in local collections. The type from the British Museum is figured here.

Oliarus procellaris Kirkaldy.
Oliarus procellaris Kirkaldy, 1909:77. Giffard, 1925:147.

Endemic. Oahu (type locality: Konahuanui).
Giffard reported that no examples of this species could be found in the British Museum or in Honolulu, and the species remains unknown to us. It could not be located at the British Museum in 1946 when a request to have it drawn for this text was made.

Oliarus silvestris Kirkaldy (figs. 34, 1; 43).
Oliarus silvestris Kirkaldy, 1909:78. Giffard, 1925:132, pl. 6, figs. 97, 98, 101.

Endemic. Kauai (type locality: 4,000 feet).

Oliarus similis Giffard (figs. 34, b; 43).
Oliarus similis Giffard, 1925:139, pl. 8, figs. 127, 128.

Endemic. Lanai (type locality: 2,000 feet).
Giffard noted that this is "A very variable species superficially and structurally like the preceding (*inaequalis*), to which it is very closely related." He also reported finding individual variations in the structure of the male genitalia.

Oliarus similis lanaiana Metcalf.
Oliarus similis variety *a* Giffard, 1925:140.
Oliarus similis variety *lanaiana* Metcalf, 1936:101.

Endemic. Molokai, Lanai, Maui (type locality: Wailuku).

Oliarus similis mauiana Metcalf.
Oliarus similis variety *c* Giffard, 1925:141.
Oliarus similis variety *mauiana* Metcalf, 1936:101.

Endemic. Maui (type locality: Halehaku).

Figure 43—*Oliarus* species. Top row, left to right: *O. nubigenus* Kirkaldy, male; *O. opuna* Kirkaldy, topotype female, probably from type series; *O. pele* Kirkaldy, male. Bottom row, left to right: *O. silvestris* Kirkaldy, female; *O. similis* Giffard, paratype male; *O. tantalus* Giffard, male.

Oliarus similis molokaiana Metcalf.

Oliarus similis variety *b* Giffard, 1925:141.

Oliarus similis variety *molokaiana* Metcalf, 1936:101.

Endemic. Molokai, Maui (type locality: Olinda).

Oliarus swezeyi Giffard (figs. 32, B; 33, g; 34, o).

Oliarus swezeyi Giffard, 1925:67, pl. 1, fig. 7; pl. 2, figs. 15, 22, 23–26.

Endemic. Kauai (type locality: Olokele Canyon).

This is an ally of *muiri,* which see.

Oliarus tamehameha Kirkaldy (figs. 31; 34, j).

Oliarus tamehameha Kirkaldy, 1902.120, pl. 4, fig. 4. Giffard, 1925.81, pl. 1, fig. 11; pl. 4, figs. 50, 51. (Type of *Nesoliarus.*)

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet)

Figure 44—*Oliarus* species: *O. tarai* Kirkaldy, female, left; *O. waialeale* Giffard, female, middle; *O. wailupensis* Giffard, female, right.

Oliarus tantalus Giffard (figs. 33, a; 43).
Oliarus tantalus Giffard, 1925:71, pl. 1, fig. 1; pl. 3, figs. 32, 33.

Endemic. Oahu (type locality: Palolo Valley).
This is an associate of *kaiulani*, and I am not sure that it is a distinct species.

Oliarus tarai Kirkaldy (fig. 44).
Oliarus tarai Kirkaldy, 1902:123, pl. 4, figs. 6, 9. Giffard, 1925:97, pl. 5, figs. 72–75.

Endemic. Oahu (lectotype locality: Waianae).

Oliarus tarai hawaiiensis Metcalf.
Oliarus tarai variety *a* Kirkaldy, 1902:123.
Oliarus tarai variety *hawaiiensis* Metcalf, 1936:105.

Endemic. Maui (type locality: Haleakala).
Giffard did not list this form in his revision.

Oliarus tarai kohalana Metcalf.
Oliarus tarai variety *a* Giffard, 1925:105.
Oliarus tarai variety *kohalana* Metcalf, 1936:105.

Endemic. Hawaii.

Oliarus waialeale Giffard (figs. 34, a; 44).
Oliarus waialeale Giffard, 1925:125, pl. 6, figs. 92, 93.

Endemic. Kauai (type locality: Waialeale Trail, 5,000 feet).
A variable, close ally of *kauaiensis*.

Oliarus wailupensis Giffard (fig. 44).
Oliarus wailupensis Giffard, 1925:76, pl. 3, figs. 39, 40.

Endemic. Oahu (type locality: Wailupe).
This is an associate of *kaumuahona*.

Genus IOLANIA Kirkaldy, 1902:118

Iolania is a group which Kirkaldy, Muir and Giffard considered was an offshoot of the world-wide *Cixius*. It is easily distinguished from *Oliarus* because it has only three keels on the mesonotum instead of five. Until 1931 it was considered endemic, but Muir (1931:66–67) described two new species from Queensland and assigned them to this genus. I doubt that the Hawaiian and Australian species are monophyletic.

Giffard saw no examples from Kauai or Molokai, but specimens have since been collected from both these islands. This new material has not been examined critically and I have not included the records in this text.

Kirkaldy recognized a single species among the series of examples from several islands studied by him. However, Giffard split the group into five species on the basis of differences found in the male genitalia only, and he stated that it was practically impossible to separate the species by any other method. I am not altogether convinced that there are five full species involved here and suggest that further studies be made.

Kirkaldy gave the varietal name *notata* to the form which has "a large brown blotch at the base of the tegmina in the male." This was not recognized by Giffard, who stated that no type of this form could be located either at the British Museum or in Honolulu. Kirkaldy did not mention any locality for *notata,* and it appears that until the type can be located it will be impossible to tell whether the variety applies to *perkinsi,* or to one of Giffard's species, or whether the name applies to a similar form of each of the five "species." For the time being, I have listed it under *perkinsi* as it was first described.

These insects frequent ferns. The adults have also been collected at lights.

The "species" of this genus can be distinguished on the basis of their distribution, excepting that two forms occur together on Oahu. A study of the male genitalia and a comparison with the illustrations will be essential to separate these two latter species. I have failed to find external characters from which to assemble a key.

Iolania koolauensis Giffard.

Iolania koolauensis Giffard, 1925:154, pl. 8, figs. 141–142.

Endemic. Oahu (type locality: Waiahole).

Iolania lanaiensis Giffard (fig. 45).

Iolania lanaiensis Giffard, 1925:155, pl. 8, fig. 136.

Endemic. Lanai (type locality: 3,000 feet).

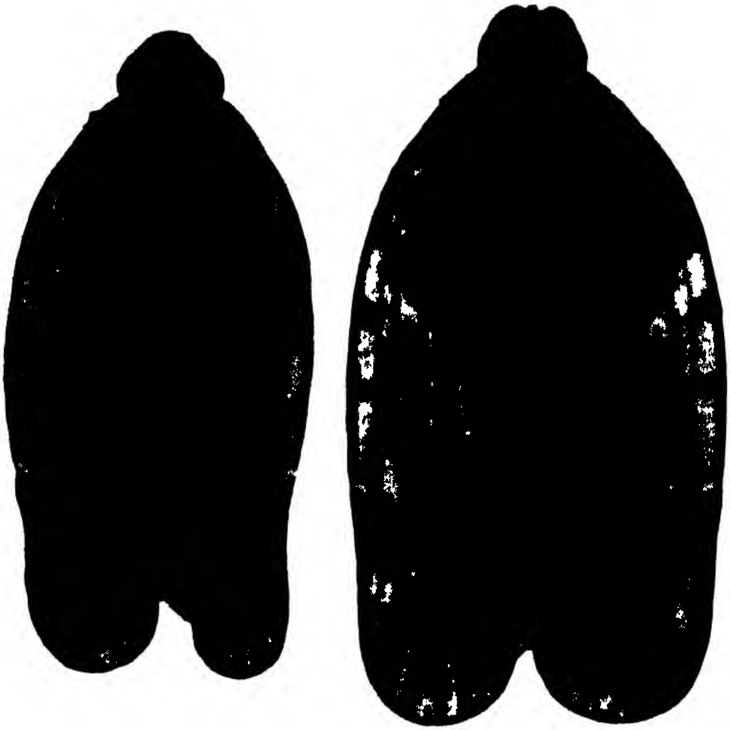

Figure 45—*Iolania oahuensis* Giffard, male, left; *Iolania lanaiensis* Giffard, female, right.

Iolania mauiensis Giffard.
Iolania mauiensis Giffard, 1925:155, pl. 8, fig. 135.

Endemic. Maui (type locality: Waialuaiki).

Iolania oahuensis Giffard (fig. 45).
Iolania oahuensis Giffard, 1925:154, pl. 8, fig. 138.

Endemic. Oahu (type locality: Palolo Valley).

Iolania perkinsi perkinsi Kirkaldy (figs. 31; 34, p).
Iolania perkinsi Kirkaldy, 1902:119, pl. 4, fig. 3. Giffard, 1925:153, pl. 8, fig. 134. Genotype.

Endemic. Hawaii (type locality: Kilauea).

Iolania perkinsi notata Kirkaldy.
Iolania perkinsi variety *notata* Kirkaldy, 1909:75.

Endemic. Hawaii (type locality unknown to me).

Family DELPHACIDAE (Leach, 1815)

Asiracidae (Motschulsky, 1863).
Araeopidae Metcalf, 1938:297.

Metcalf, in his paper "The Fulgorina of Barro Colorado and Other Parts of Panama" (1938), erected the family name Araeopidae to replace the old name of Delphacidae. He considered *Delphax* Fabricius, 1798, to be preoccupied by the mammalian generic name of *Delphax* Walbaum, 1792 (listed from Klein's work of 1744). However, as pointed out by Fennah (1944), Opinion 21 handed down by the International Commission of Zoological Nomenclature was overlooked, for it states that the *Delphax* of Klein and Walbaum is not available under the rules. Opinion 21 reads as follows: "Shall the Genera of Klein, 1744, Reprinted by Walbaum, 1792, be Accepted?—When Walbaum, 1792, reprinted in condensed form (but did not accept) the genera of Klein, 1744, he did not thereby give Klein's genera any nomenclatorial status, and Klein's genera do not therefore gain availability under the present Code by reason of being quoted by Walbaum." Thus, Araeopidae of Metcalf becomes a synonym of the old and well-known family name Delphacidae.

This is the largest of the fulgoroid families. In 1943, Metcalf listed 137 genera containing 1,114 species as known from the world. Of these, 14 genera and 145 species and lesser forms are known from the Hawaiian Islands. Thus, our local fauna is one of the richest in the world. Certainly for its area Hawaii has a great concentration of species, and a number of new endemic species are yet to be described.

These are usually small insects which can be distinguished readily from all our other leafhoppers because they have a large, conspicuous, movable spur or calcar on each hind tibia.

There are three types of winged forms. In some, the tegmina are fully developed, usually surpass the apex of the abdomen, have fully developed venation and these individuals are termed macropterous forms. The second group, containing the koeliopterous forms, have the venation somewhat reduced and the tegmina are somewhat shortened and do not extend beyond the abdomen and may not completely cover it. The third, or brachypterous, forms have the tegmina much reduced with greatly reduced venation and the tegmina may cover only the base of the abdomen. The hind wings are fully developed only in the macropterous forms. Some species are known to include individuals of all three forms, whereas others are known only from the macropterous or brachypterous forms.

The females have the ovipositor well developed, and the eggs are inserted into punctures made in plant tissues.

This is the largest hemipterous family in our fauna. Kirkaldy and Muir, both of whom resided in Hawaii, described nearly all of our species. Some of the

genera and a large number of the species were described after *Fauna Hawaiiensis* was completed. Giffard and especially Swezey have collected the bulk of the species and have recorded a large amount of data on the hostplants and habits of the insects.

The native delphacids are attacked by a number of parasites, but our knowledge of this parasitism is meager. Pipunculid flies, the dryinid wasps *Echthrodelphax fairchildii* Perkins, *Pseudogonatopus perkinsi* (Ashmead), and the strepsipteron *Elenchus melanias* Perkins and its variety *silvestris* Perkins are known to attack various leafhoppers. "Stylopized" or pipunculid-attacked nymphs and adults are found frequently among series of specimens of many species. Certain tiny mymarid *Polynema* wasps attack the eggs. A most interesting study and worth-while contribution could be made by a keen student who would make a careful and detailed survey of the parasites of our native leafhoppers and their habits. In addition to these parasites, there are several purposely introduced parasites which have been brought in to check immigrant leafhopper pests, and these latter parasites are discussed farther on in the text. Many of the native leafhoppers have become increasingly rare in recent years. The introduction of foreign parasites to control the sugarcane leafhopper may account for this. Some species, once common, are now difficult to find. The number of extinct species is probably large.

An interesting manifestation of the parasitic attack, which I have noticed among species of *Nesosydne* particularly, is the variable amount of castration that takes place. On some males, the genitalia may be only slightly affected, or, in the extreme, the entire sexual apparatus may be aborted. Some specimens may appear to belong to species other than their own, because if a slight amount of change takes place, the genital styles, for example, may appear to be fully developed but of a decidedly different shape from normal styles. Some examples examined have the styles considerably reduced in size, other specimens have them nearly obsolete, and still others have the entire assemblage of genital processes of the pygophore obliterated with a simple concavity remaining in the pygophore. Apparently this differential castration is the result of differences in time of attack by the parasite, or at least differences in the time when the gonads have been attacked or the amount of damage done to them before the ultimate nymphal molt. It would not be surprising to learn that some partially castrated specimens form the types of "new species," but the author of such species could hardly be blamed for considering them distinct species if the series supplied him for study was inadequate. Here is another field worthy of detailed investigation. I have found that Muir (1916:210) commented upon the same phenomenon.

The native species show great host specificity and are nearly all restricted to native plants. On the other hand, the few immigrant forms include important crop pests, among them the notorious sugarcane leafhopper. In fact, it was the latter pest that gave the great impetus in Hawaii to economic entomological research that has been centered at the Experiment Station of the Hawaiian Sugar Planters' Association. The following quotations from Giffard (1922:103–104) will not be out of place here:

Because our endemic leaf-hoppers, like some others elsewhere, do not particularly affect agricultural interests, and therefore are of no special economic importance, some may wonder why so much interest is taken in their biology and morphology by our local entomologists. There are several reasons for this. First, because of several very injurious species of hoppers, not so very far from our gates, which as yet have not reached Hawaii; and, second, because the sugar cane leaf-hopper (*Perkinsiella saccharicida*), which cost this Territory losses of many millions of dollars in 1903, 1904 and subsequent years, is, as it were, the foundation-stone of economic entomology in Hawaii. Not only was this Delphacid responsible for large money losses, but it was also the cause for organizing in 1903 a large staff of entomologists for biological research and field work in the Territory, and the building up such organizations as the Experimental Station of the Hawaiian Sugar Planters' Association and the Territorial Board of Agriculture and Forestry and its Plant Quarantine and Inspection Department. It is therefore not surprising that the many families and groups of leaf-hoppers distributed through both continents are of more than passing interest to some of our systematic as well as economic workers. The systematic study of these families or groups, whether local or foreign, is quite necessary because, with Hawaii as the "Cross Roads of the Pacific" and in almost daily steamship communication with many tropical or sub-tropical regions, there is always the possibility that one or more of the several known species of hoppers or other injurious insects may be accidentally introduced. In this connection, as an instance, it might here be recorded that in 1913 Mr. J. C. Bridwell, while in Nigeria, West Africa, collected there among other material for study in Honolulu, a small Delphacid, allied to our own sugar cane leaf-hopper, which Mr. Muir later described as *Megamelus flavolineatus*. During the past year Mr. Muir has received collections of leafhoppers from Porto Rico (where insects of some sort are carrying mosaic disease in sugar cane) and among these he found this West African species of which Mr. Wolcott, the entomologist in Porto Rico, remarks: "The identification of *M. flavolineatus* was especially fortunate, as this is a cane insect which may become a serious pest." The fact, therefore, that these insects convey many plant diseases also makes their study necessary for economic work. Knowledge acquired purely from scientific studies sooner or later is the foundation of applied practices, as is well instanced in the "Fauna Hawaiiensis," without which we never could have handled our local entomological problems with the same degree of certainty.

In contrast to continental areas where so many delphacid leafhoppers are attached to grasses and sedges, not one of the 134 species of our 7 endemic genera feeds upon such plants. The five native forms of the non-endemic genus *Kelisia* are grass feeders and are our only native delphacids which are attached to grasses. All our other species feed upon trees, vines, shrubs, herbs and ferns; most of them are attached to trees.

The hostplant relationships of our delphacids have received much attention, but much remains to be done. It must be kept in mind that adults of both long- and short-winged forms often may be taken from plants upon which they happen to be resting but upon which they do not breed. Hence, the hostplant records for not a few of our species are, I believe, inaccurately recorded. Many of our species are known from only one or a few specimens, and thus their host records cannot be relied upon entirely. A number of species, however, have been observed breeding upon given plants, and such records are the only reliable ones. Some species are known to breed on several or many kinds of plants, but the majority of them are confined to one species or one genus of plants. Some of them are remarkably restricted in their food habits.

The following plant genera are fed upon by one or more species of endemic Delphacidae, insofar as is now known:

Acacia	*Eragrostis*	*Pittosporum*
Alphitonia	*Eugenia*	*Plectranthus*
Antidesma	*Euphorbia*	*Platydesma*
Argyroxiphium	*Freycinetia*	*Polygonum*
Artemisia	*Geranium*	*Pritchardia*
Astelia	*Gouldia*	*Raillardia*
Bidens	*Gunnera*	*Rollandia*
Bobea	*Herpestes*	*Rumex*
Boehmeria	*Ipomoea*	*Sadleria*
Broussaisia	*Jussiaea*	*Scaevola*
Campylotheca	*Kadua*	*Sesbania*
Charpentiera	*Lipochaeta*	*Sida*
Cheirodendron	*Lobelia*	*Sideroxylon*
Cibotium	*Lythrum*	*Smilax*
Clermontia	*Metrosideros*	*Sporobolus*
Coprosma	*Mucuna*	*Stenogyne*
Cyanea	*Myoporum*	*Straussia*
Cyrtandra	*Myrsine* (*Suttonia*)	*Strongylodon*
Deschampsia	*Nephrolepis*	*Styphelia* (*Cyathodes*)
Diospyros (*Maba*)	*Osmanthus*	*Syzygium*
Dodonaea	*Pelea*	*Tetramolopium*
Dolichos	*Phegopteris*	*Touchardia*
Dubautia	*Phyllostegia*	*Urera*
Elaeocarpus	*Pipturus*	*Vincentia*

It is probable that a careful search of other genera of endemic plants will reveal the presence of many new kinds of leafhoppers. New forms, moreover, will be found on the same genera of plants on islands or isolated localities other than in the places where there are known species on given hosts. Also, we do not know the hostplants of the following 18 species: *Leialoha pacifica* (Kirkaldy), *Nesothoë frigidula* Kirkaldy, *Nesothoë silvestris* Kirkaldy, *Nesosydne haleakala* Kirkaldy, *N. hamadryas* Kirkaldy, *N. hamata* Muir, *N. incommoda* Muir, *N. koebelei* Muir, *N. nephelias* Kirkaldy, *N. nesogunnerae* Muir, *N. nigriceps* Muir, *N. nubigena* Kirkaldy, *N. palustris* Kirkaldy, *N. perkinsi* Muir, *N. procellaris* Kirkaldy, *N. rocki* Muir, *N. sola* Muir and *N. swezeyi* Muir.

As noted elsewhere, many of the male specimens were dissected before being described by Muir, and not a few of these are unique. Evidently the balsam mounts of the genitalia of these species were made by Muir and Giffard, perhaps mostly by Giffard. These slides are assembled in Giffard's collection and serially numbered. A corresponding number was usually attached to the pin of the specimen from which the organs were obtained. However, these numbers have not been

always understood by workers who have examined Muir's material in recent years, and it is worth while to add a note regarding them here. The labels on the specimens may be clearly understandable or may be cryptic in nature. Numbers such as "42" or "mg 61" or "gen 80" or "62 mg" refer to the slides containing the mounted parts of the male genitalia of the specimen. Some examples carry a label reading "genitalia mounted," and a search of the slide boxes is required to bring these to light. Some of the genitalia are mounted with the specimen from which they were obtained—some in balsam cells in cards and others simply dry on the points. Muir's sketches of the genitalia must be used with care, for some of them are poorly made or are inaccurate or misleading.

In the foregoing discussion following the key to the families of Cicadoidea, I drew attention to a letter from Dr. Perkins in which he included numerous notes on Kirkaldy's type material of Hawaiian leafhoppers. The notes on the delphacids have been incorporated hereinafter in their appropriate places, with reference to "Perkins' letter."

For detailed bibliographic notes, the student is referred to Metcalf's (1936) world catalogue, because only the more important references are listed under each species here, although all the descriptive papers do appear in the bibliography at the end of this volume.

Unless otherwise stated in the text, the holotypes of our delphacids are in the collection of the Experiment Station, Hawaiian Sugar Planters' Association, at Honolulu.

Subfamily DELPHACINAE Jensen-Haarup, 1915

Araeopinae Metcalf, 1938:299.

We have representatives of only one of the two recognized subfamilies in our Territory. The Asiracinae do not occur in Hawaii, but that group is present in Samoa, Fiji and westward in the Pacific.

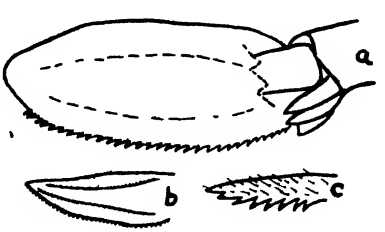

Figure 46—Hind tibial calcars of some delphacids: a, *Tarophagus proserpina* (Kirkaldy); b, *Perkinsiella saccharicida* Kirkaldy; c, *Aloha ipomoeae* Kirkaldy.

Key to the Tribes of Delphacinae Found in Hawaii

1. Calcar of hind tibiae solid, with both surfaces convex and distinctly dentate along hind margin, the teeth large and strongly developed (fig. 46, c)...................... **Alohini.**
2. Calcar of hind tibiae thin or lamina-like or foliaceous or somewhat hollow sub-V-shaped in cross section because of one side being concave(not solid V-shaped, which would would be triangular), with or without teeth on hind margin, if teeth are present they are many and minute (as on our species) (fig. 46, a, b)...................... **Delphacini.**

Tribe ALOHINI Muir, 1915:269

At one time it was thought that this tribe was restricted to the Hawaiian Islands, but further collecting and study have shown the group to be world-wide in distribution.

From the Delphacini, the only other group of delphacids found in Hawaii, this tribe is distinguished by having both sides of the posterior tibial calcar convex and with strongly developed teeth on the hind margin, as shown in the drawing. Thus the calcar resembles the blade of a pruning saw.

All our native delphacid leafhoppers with the exception of the grass-inhabiting *Kelisia* belong to this tribe.

Key to the Genera of the Alohini of Hawaii

1. First segment of antennae short, usually broader than long, or about as broad as long, never conspicuously longer than broad except in the aberrant *Nesothoë silvestris* in which it is about twice as long as broad, but the face is conspicuously pale-spotted and the tegmina are strongly compressed or constricted at the base of the apical cell area; all species macropterous; (certain species of *Nesosydne*, *N. cyathodis* for example, run here because of their short first antennal segments, but they have a single median frontal carina and are brachypterous)................. 2
   First segment of antennae distinctly longer than broad, face never pale-spotted; most species brachypterous, only a few macropterous, but if macropterous with tegmina not strongly constricted subapically............. 4

2(1). With two median frontal carinae, approximating at base or apex or both, or even meeting, but not forming a stalk .... **Leialoha** (Kirkaldy).
   With only a single median frontal carina, forked at extreme base, if at all.............................. 3

3(2). Male pygophore with a large, upcurved spine-like process on each lateral margin at about middle, a pair of style-like spines behind genital styles at middle of hind mar-

gin and with two anal styles; female with two anal styles, lower one very large and protruding far behind apex of abdomen (see illustrations) .... **Nesodryas** Kirkaldy.

Male pygophore without lateral spines and without accessory spine-like processes behind genital styles; anal styles single and small in both sexes .... **Nesothoë** Kirkaldy.

4(1). With two median frontal carinae (check your specimen carefully, for the two carinae may seem to be one) 5

With only one median frontal carina (which, however, may be furcate above apex) 6

5(4). Tegmina reaching well beyond middle of abdomen .... **Aloha** Kirkaldy.

Tegmina short, not reaching to middle of abdomen .... **Nesorestias** Kirkaldy.

6(4). Head abnormally and enormously prolonged forward to form a long horn .... **Dictyophorodelphax** Swezey.

Head normal, not produced forward 7

7(6). Tegmina much abbreviated, not reaching past middle of abdomen, veins obscured and broken down into a coarse reticulation .... **Nothorestias** Muir.

Tegmina usually reaching nearly to or surpassing apex of abdomen, veins distinct, but if wings greatly abbreviated, then veins not broken down to form a coarse reticulation .... **Nesosydne** Kirkaldy.

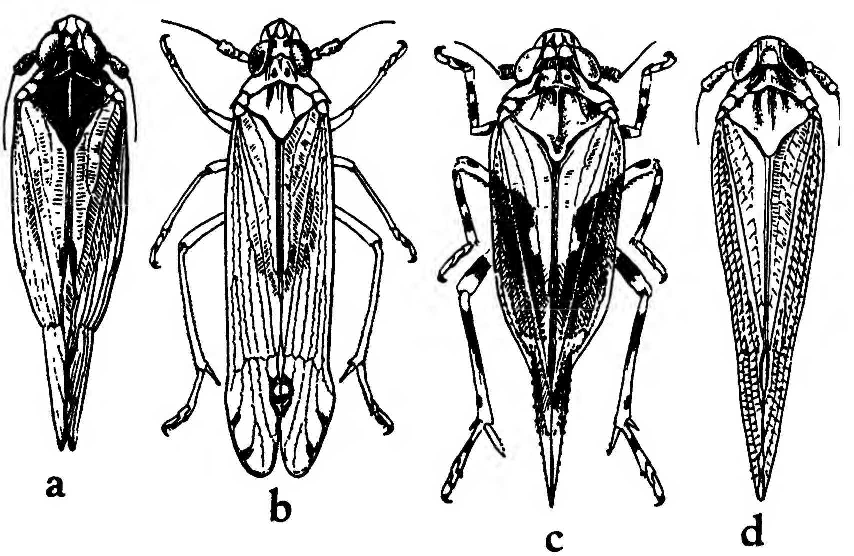

Figure 47—Some native delphacid leafhoppers: a, *Leialoha scaevolae* Muir; b, *Nesodryas freycinetiae* Kirkaldy; c, *Nesothoë fletus* Kirkaldy; d, *Nesosydne koae* Kirkaldy. (Drawings by Abernathy.)

All the genera of the Hawaiian Alohini are not as distinct from one another as a review of the literature would appear to indicate. There are certain species in several genera which cannot be placed in their assigned genera by the use of existing keys. For example, *Nesothoë silvestris* has the first antennal segment about twice as long as broad, yet this genus is assigned to a group which Muir characterized as having the first antennal segment "very short, broader than long." Some of the species of *Nesosydne* have the median frontal carina forking far down on the face so that the frons has two median carinae for much of its length. These species might be placed in *Aloha* or *Nesorestias.* In fact, Muir placed *Nesosydne wailupensis* first in *Aloha*, then later transferred it to *Nesosydne.* The close interrelationships of the local genera within the Alohini are conspicuous and evident, and most of the evolutionary story is yet to be written.

Genus **LEIALOHA** (Kirkaldy) Muir, 1915:264

Aloha subgenus *Leialoha* Kirkaldy, 1910:579.

The known species of this endemic genus are all macropterous; the first antennal segment is broader than long, or only slightly longer than broad, and the front of the head has two median carinae. It is a close associate of *Nesothoë.*

This is a confusing group, and I do not believe that it is in good taxonomic order. The assemblage of forms centering around *ohiae* and *lehuae* caused Muir considerable trouble. Much work remains to be done here. It would be advisable to collect a series of specimens from the same colony and study them to see if there is variation in the aedeagus. I do not believe that this has been done. The shape, position and size of the spines on the aedeagus differ according to the way they are oriented in the balsam mount. I do not believe Muir allowed for this apparent variation.

There is much variation in the color and color patterns of the adults, and the formulation of a key is difficult. Only use will decide the worth of the table presented here, but I feel that it is inadequate. I have failed to detect good differences to use for the separation of various of these forms.

I do not now feel that the associates of *lehuae* should be accorded full specific rank, but I am not familiar enough with the group to make a decision regarding them. Some of them were described as subspecies by Muir, who later considered them to be species. I have listed them all here as species, and leave the task of assigning them to their appropriate ranks to some future specialist who can make a concerted study of them.

Another problem that needs solution is the geographical distribution of the various forms. I have followed Muir and Giffard in recording the distribution, but I feel that if the forms are really distinct it will ultimately be shown that they have a more restricted distribution than is indicated here.

Key to the Species of Leialoha

1. Kauai species 2
   Not so 8

2(1). "Similar to *A.* [*Leialoha*] *oceanides,* but proportionately slightly more robust. The whole of the tegmina basal of the apical cells is dark smoky except the basal fourth of that space, the subcostal cell in part, the apex of the clavus, and the tegminal granules, the latter supporting white hairs. Apical keels of the vertex and the middle keels of the pronotum and scutellum subsanguineous." (Kirkaldy, original description, 1910:581; this species has not been found since the type was collected) .... **pacifica** (Kirkaldy).
   Not such species 3

3(2). Tegminal membrane mostly hyaline but with extensive and conspicuous dark maculations; granules of veins unusually conspicuous, coarse and pale .... **oceanides** (Kirkaldy).
   Tegmina without such a combination of characters 4

4(3). Body and appendages largely yellowish or pale brown (although vertex and nota are dark in males), general aspect pale, or, in males, comparatively pale with dark markings 5

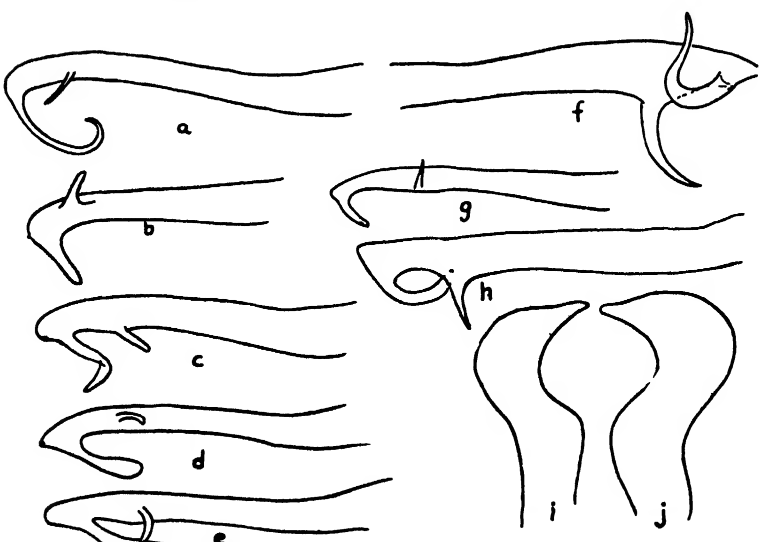

Figure 48—Features of male genitalia of *Leialoha* (a–h are aedeagi): a, *L. kauaiensis* (Muir); b, *L. naniicola* (Kirkaldy); c, *L. lanaiensis* (Muir), holotype; d, *L. ohiae* (Kirkaldy); e, *L. oahuensis* (Muir); f, *L. oceanides* (Kirkaldy); g, *L. lehuae* (Kirkaldy), from an example from Kauai labeled "typical" by Muir; h, *L. hawaiiensis* (Muir); i, left style of *L. ohiae* (Kirkaldy); j, right style of *L. oahuensis* (Muir). These drawings were made by me from dissected specimens studied by Muir and some of them are the same as those from which he made his drawings. The length, shape and position of the appendages vary according to the orientation of the specimen in the balsam mount, and these parts may appear out of place and distorted in the drawings.

Body and appendages brown to dark brown with or without a reddish tinge, general aspect of insect dark........ 6

5(4). Males with a fuscous band from base to apex of tegmina; on *Suttonia*............................**suttoniae** Muir.

Males without such a dark band, but with a dark mark at apex of clavus; on *Scaevola*..............**scaevolae** Muir.

6(4). Tegmina with extensive brown maculations, veins brownish; with little or no reddish coloration...**lehuae** (Kirkaldy).

Tegminal veins usually conspicuously reddish, and entire insect with considerable reddish coloration............ 7

7(6). Dark maculations of tegmina ill-defined or obscure; male aedeagus as in figure 48, d.............**ohiae** (Kirkaldy).

Dark maculations of tegmina conspicuous and extensive; male aedeagus as in figure 48, a........**kauaiensis** (Muir).

8(1). Maui species...........................**mauiensis** (Muir).

Not so.. 9

9(8). Lanai form, with apical hook of aedeagus curved backward, as in figure 48, c................**lanaiensis** (Muir).

Not from Lanai (with exception of *oahuensis*) and with apical hook of aedeagus curved forward................10

10(9). Predominantly reddish species...........**ohiae** (Kirkaldy).

Predominantly brownish species with conspicuously maculate tegmina..11

11(10). Very dark (sometimes nearly black) form from Hawaii; aedeagus as in figure 48, h...........**hawaiiensis** (Muir).

Not so...12

12(11). Comparatively pale form with fuscous maculations of tegmina small and scattered; aedeagus as in figure 48, b.................................**naniicola** (Kirkaldy).

Not so, infuscation of tegmina more extensive...........13

13(12). Nearly all of tegmina fuscous; aedeagus as in figure 48, g.................................**lehuae** (Kirkaldy).

Tegmina distinctly pale and dark maculated or banded, not almost entirely dark; aedeagus as in figure 48, e.................................**oahuensis** (Muir).

Leialoha hawaiiensis (Muir) (fig. 48, h).

Leialoha lehuae subspecies *hawaiiensis* Muir, 1916:173, pl. 2, fig. 4.

Endemic. Hawaii (type locality: Waimea).
Hostplant: *Metrosideros* ("ohia lehua").

Leialoha kauaiensis (Muir) (fig. 48, a).

Leialoha lehuae subspecies *kauaiensis* Muir, 1916:173, pl. 2, fig. 5.
Leialoha kauaiensis (Muir) Muir, 1922:93.

Endemic. Kauai (type locality: Waimea).
Hostplant: *Metrosideros*.

Leialoha lanaiensis (Muir) (fig. 48, c).
Leialoha lehuae subspecies *lanaiensis* Muir, 1917:299, pl. 5, fig. 1.

Endemic. Lanai (type locality: Kaiholena).
Hostplant: *Metrosideros.*
The distal spine on the aedeagus is curved backward on the holotype slide, but I feel that this might be an artificial condition brought about during the mounting of the genitalia. More material should be examined.

Leialoha lehuae (Kirkaldy) (fig. 48, g).
Aloha (Leialoha) lehuae Kirkaldy, 1910:581.
Leialoha lehuae (Kirkaldy) Muir, 1916:172–173, pl. 2, fig. 2.

Endemic. Oahu (type locality: Mount Tantalus), Lanai.
Hostplant: *Metrosideros.*
This is a variable and confusing form. Kirkaldy considered it close to the original type of ancestral immigrant which gave rise to our endemic Alohini.
The holotype is in the Bishop Museum.

Leialoha mauiensis (Muir).
Leialoha lehuae variety *mauiensis* Muir, 1919:87.

Endemic. Maui (type locality: Olinda, 4,200 feet).
Hostplant: *Metrosideros.*
This species has been credited as feeding on *Coprosma montana*, but I believe that this is in error and that its true host is *Metrosideros.* I have seen topotypic material collected by Swezey from *Metrosideros*, and on one of the paratypes dissected by Giffard there appears the note "*Coprosma montana* and ohia mixed" (the "ohia" refers to *Metrosideros*).

Leialoha naniicola (Kirkaldy) (fig. 48, b).
Aloha (Leialoha) naniicola Kirkaldy, 1910:580.
Leialoha naniicola (Kirkaldy) Muir, 1916:172, pl. 2, fig. 1; pl. 4, fig. 75. Genotype.

Endemic. Oahu (type locality: "Waianae Mts., not from Kilauea as given in F. H."; Perkins, *in litteris*), Hawaii.
Hostplant: *Metrosideros.*
"I could find in K's boxes no specimens from Kilauea (Perkins and Kirk.); nor any Swezey and Kirk. from Tantalus; but there were one or two Giffardian exx. thence. The specific name *'olopana'* was on the 'type' but *naniicola* was beneath the specimens" (Perkins' letter). The type should be in the British Museum.

Leialoha oahuensis (Muir) (fig. 48, e, j).
Leialoha lehuae subspecies *oahuensis* Muir, 1916:173, pl. 2, fig. 3.

Endemic. Oahu (type locality: Kalihi), Lanai.
Hostplant: *Metrosideros.*

Leialoha oceanides (Kirkaldy) (fig. 48, f).
Aloha (*Leialoha*) *oceanides* Kirkaldy, 1910:580.
Leialoha oceanides (Kirkaldy) Muir, 1916:174; 1922:92, pl. 3, fig. 1.

Endemic. Kauai (type locality: 4,000 feet).
Hostplant: *Osmanthus sandwicensis.*
The type is supposedly in the British Museum. Perkins notes that one of the original specimens in his collection was labeled by Kirkaldy as *"honiala,"* a manuscript name.

Leialoha ohiae (Kirkaldy) (fig. 48, d, i).
Aloha (*Leialoha*) *ohiae* Kirkaldy, 1910:581.
Leialoha ohiae (Kirkaldy) Muir, 1916:174, pl. 2, fig. 6.

Endemic. Kauai, Oahu (type locality: Waialua), Hawaii.
Hostplant: *Metrosideros* ("ohia").
Perkins notes in his letter that the type should be in the British Museum and that some of the type lot were labeled with the manuscript name *"kahavalu."*

Leialoha pacifica (Kirkaldy).
Aloha (*Leialoha*) *pacifica* Kirkaldy, 1910:581.
Leialoha pacifica (Kirkaldy) Muir, 1916:174.

Endemic. The type locality was given as "Kauai ? Molokai ?." I have considered it more probable that the species is from Kauai. No *Leialoha* have as yet been found on Molokai, but they probably occur there. To my knowledge, this form has not been rediscovered since the type was collected, and that specimen should be in the British Museum.

Leialoha scaevolae Muir (fig. 47, a).
Leialoha scaevolae Muir, 1922:93, pl. 3, fig. 3.

Endemic. Kauai (type locality: "Kumuwela" [Kumuweia]).
Hostplants: *Scaevola chamissoniana* (*Osmanthus* and *Coprosma,* accidental ?).

Leialoha suttoniae Muir.

Leialoha suttoniae Muir, 1922:92, pl. 3, figs. 2, 2a.

Endemic. Kauai (type locality: Kalalau).
Hostplant: *Myrsine* (*Suttonia*) *sandwicensis*.

Genus **NESOTHOË** Kirkaldy, 1908:203

Subgenus *Nesothoë* (of *Nesodryas*) (Kirkaldy) Muir, 1916:174.

The discussion of this genus should be read with the notes under *Nesodryas*.

The members of *Nesothoë* were originally separated from *Nesodryas* because of the stout form of some of the species. However, they are separated here on the basis of their terminalia. The terminalia of *Nesothoë* are the same basic type as those of *Leialoha*. The pygophore of the male is simple and has no spines on the side margins as on *Nesodryas;* there is no accessory anal style in addition to the usual single style; the genital styles are as illustrated and they are not followed by an additional pair of slender style-like spines; the aedeagus is basically a rather straight or slightly curved, rod-like structure with various types of spines and processes near the apex as the illustrations show. There appears to be no basic difference between the terminalia of the typical stout members of *Nesathoë* and the slender species which were formerly placed in *Nesodryas* (see the aedeagus of *eugeniae* which is a slender species and compare the aedeagus of *munroi* which is a stout species).

Nesothoë may be defined as those species of our Alohini which have the first segment of the antennae transverse with but few known exceptions such as *silvestris* whose first segment is twice as long as broad and *perkinsi* with this segment as long as broad (the former species would run to *Nesosydne* in the generic key if it were not for its pale-spotted face and long, constricted tegmina; this fact is not apparent from the literature), and which have a single median frontal carina and the terminalia as described and figured. All the species are macropterous. The genus is derived from *Leialoha.*

It is noteworthy that the pygophore and its appendages are of relatively similar pattern in this genus as they are in *Leialoha*, whereas in *Nesosydne,* the same structures are remarkably diversified. The color pattern of the frons is striking and beautiful in some of the species.

When using the aedeagus sketches, one should keep in mind that most of them have been made from old balsam mounts made for Muir's studies, and that because of the different planes in which the appendages are situated they cannot be drawn very successfully in flat lines. Allowance should be made for optical distortion and distortion caused by compression in the thin mounts. New drawings made from new dissections mounted dry or in fluid are needed.

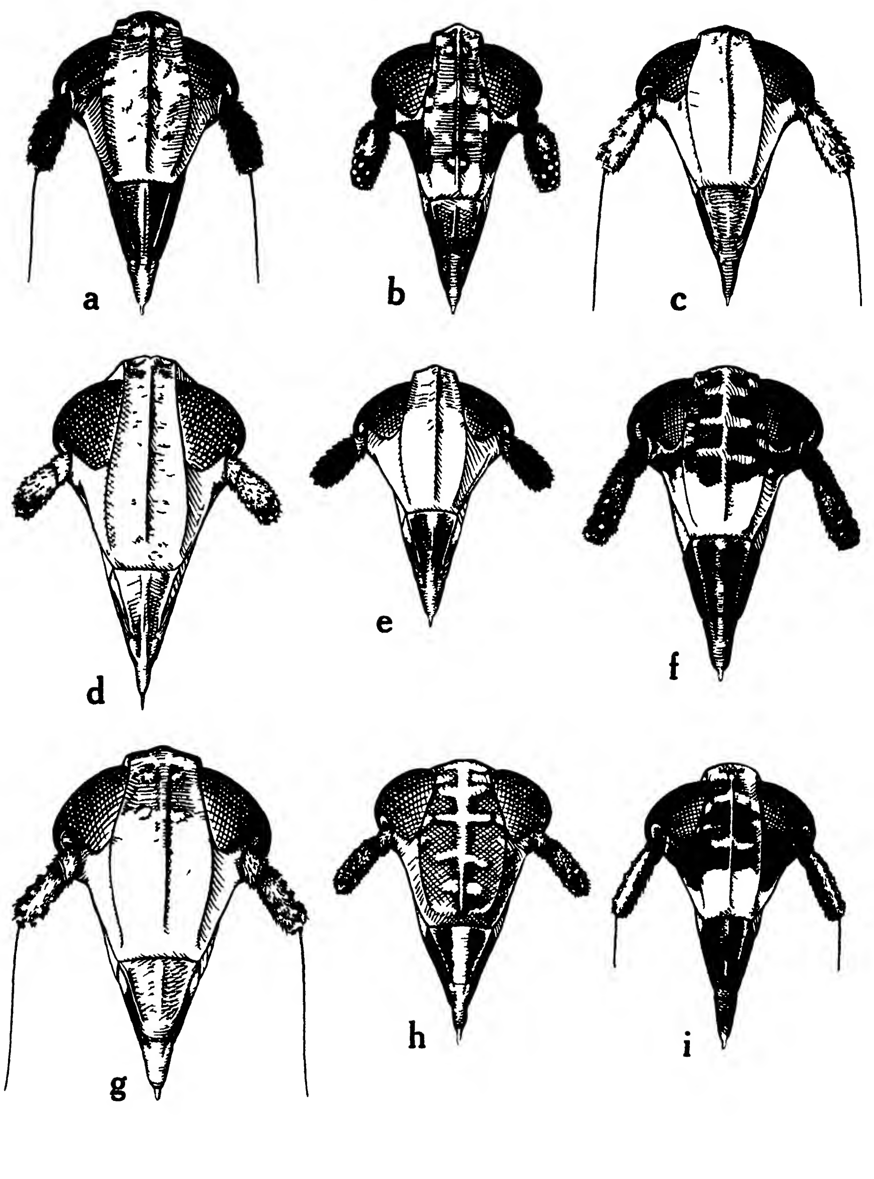

Figure 49—Faces of holotypes of *Nesothoe*: **a**, *N. fletus* Kirkaldy, female; **b**, *N. bobeae* Kirkaldy, male; **c**, *N. terryi* Kirkaldy, female; **d**, *N laka* Kirkaldy, female; **e**, *N. frigidula* Kirkaldy, female; **f**, *N. perkinsi* Kirkaldy, female; **g**, *N. pulani* Kirkaldy, female; **h**, *N. pluvialis* Kirkaldy, female; **i**, *N. hula* Kirkaldy, male. (Drawn at the British Museum of Natural History by Smith.)

Key to the Species of Nesothoë

(Excepting *laka,* which I have not seen; see the notes under that species heading below.)

Because there are two groups of species which in most instances may be distinguished rather easily by their form, the genus may be separated into two sections as an aid to determination.

A. Elongate, slender forms; tegmina usually only comparatively slightly constricted at about level of base of anal cells, as viewed from above............................**Section A.**

B. Stout, robust forms whose tegmina are strongly constricted at about base of anal cells (fig. 47, c)..............**Section B.**

SECTION A

1. Vertex and anterior part of pronotum black..**dryope** (Kirkaldy).
   Vertex and anterior part of pronotum not black.......... 2

2(1). First antennal segment, front of head and genae between eyes black or nearly so; on *Antidesma* on Oahu...**antidesmae** (Muir).
   First antennal segment and head not so marked, usually entirely pale 3

3(2). Not pallid species, but a brownish, comparatively dark form from Kauai....................**dodonaeae** (Muir).
   Largely pallid species which, in spite of fuscous markings, do not appear predominantly dark colored........ 4

4(3). Pronotum and mesonotum dark between keels.......................................**elaeocarpi** (Kirkaldy).
   Pronotum pale, mesonotum not dark in middle........... 5

5(4). Tegmina and wings milky.............**giffardi** (Kirkaldy).
   Tegmina and wings hyaline or yellowish hyaline, but not milky........................**eugeniae** (Kirkaldy).

SECTION B

1. First antennal segment about twice as long as broad; Lanai..............................**silvestris** Kirkaldy.
   First antennal segment broader than long to as long as broad, or slightly longer, but never approaching twice as long as broad.................................. 2

2(1). First antennal segment, measured carefully in full view on its longest side, as long as or slightly longer than broad (face brown with pale spots to lower level of pronotum, thence pale to the dark clypeus); Oahu.....................................**perkinsi** Kirkaldy.
   First antennal segment shorter, usually distinctly transverse 3

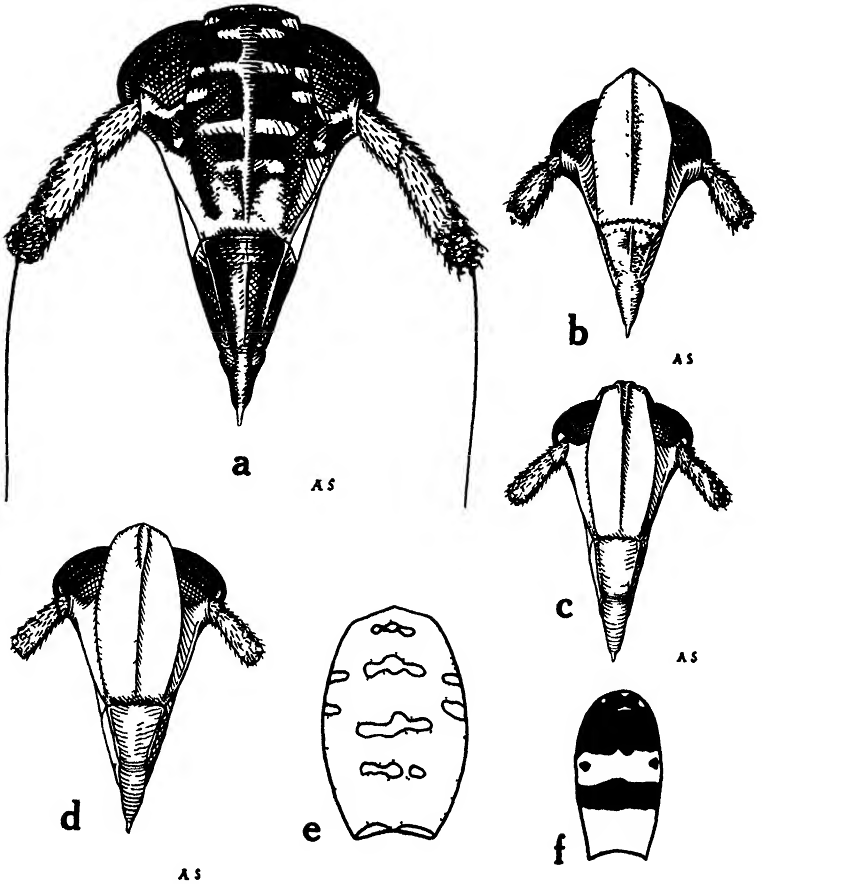

Figure 50—Faces of some delphacids a, *Nesothoe silvestris* Kirkaldy, holotype female; b, *Nesodryas freycinetiae* Kirkaldy, holotype female, c, *Nesothoe giffardi* (Kirkaldy), holotype female, d, *Nesothoe eugeniae* (Kirkaldy), holotype female, e, diagram of color pattern on frons of *Nesothoe maculata* (Muir), stippled area is brown, f, the same of *Nesothoe munroi* (Muir). (Figures a–d drawn at the British Museum of Natural History by Smith.)

3(2). First or second antennal segment, or both, largely dark, nearly or quite black 4

Antennae entirely pale or brown, first segment never much darker than second and second never very dark ...14

4(3) Frons dark or black between eyes and with a conspicuous, dark, transverse band between lower edges of sides of pronotum, elsewhere nearly all yellow, frons thus with two dark and two pale fasciae conspicuously contrasting (fig. 50, f); antennae entirely black; Hawaii ....**munroi** (Muir).

Face without such a striking color pattern, at least not as in figure 50, f 5

5(4). Mesonotum, pronotum, vertex, frons, genae and clypeus almost or entirely dark or black; tegmina largely brown from base to middle, but with white maculae and with apical half white and sharply contrasted with darker basal half (at least on the unique holotype); Kauai .... **semialba** (Muir).
Not such species 6

6(5). Vertex and anterior part of pronotum black, frons, clypeus and genae pale yellow; tegmina mostly hyaline with some infuscation in basal half only .... **dryope** (Kirkaldy).
Vertex and pronotum pale or brown, but not very dark and otherwise not as above 7

7(6). Vertex and disc of pronotum white or creamy white, mesonotum mostly black; tegmina largely immaculate hyaline .... **hula** Kirkaldy.
Not such species 8

8(7). Frons brown or black from lower level of sides of pronotum upward with some pale spots on interocular area, but white or creamy from lower level of pronotum to clypeus which is largely dark; tegmina with brown maculae 9
Without such a combination of characters 10

9(8). Oahu form .... **perkinsi** Kirkaldy.
Kauai form .... **seminigrofrons** (Muir).

10(8). Tegmina mostly hyaline tinged with yellowish or pale fuscous basad, but without any dark maculae distad.. .... **frigidula** Kirkaldy.
Tegmina conspicuously dark maculate 11

11(10). Vertex and frons almost entirely yellow; tegmina with a striking color pattern consisting of a broad, oblique, milky-white band extending from entire base diagonally to include much of clavus, a similarly colored, large crescent basad on costa and extending from about middle to about apex and extending about half way across tegmen at its broadest part; tegmina otherwise almost uniformly brown, the brown area itself assuming a more or less crescent-like shape ...... **fletus** Kirkaldy.
Not such species 12

12(11). Disc of mesonotum dark brown; frons with dark ground color extending to apex and without a broad pale apical band (but pale spotted) .... **maculata** (Muir).
Disc of mesonotum pale brown; frons broadly pale or white from level of inflexed sides of pronotum distad... 13

13(12). Oahu species; granules on tegmina very conspicuous with membrane suffused around their bases over entire tegmina .... **bobeae** Kirkaldy.
Hawaii species; granules distinct but not outstanding and membrane not suffused around their bases, few, obscure or partly absent in pale subcostal area outward from apical cells .... **haa** (Muir).

14(3). Tegmina conspicuously milky-white with some restricted pale-brown maculae; disc of mesonotum darker than sides, frons and genae pale yellow below level of eyes; Molokai, (Lanai ?)....................**piilani** Kirkaldy.
Not such species....................................15
15(14). Tegmina almost entirely hyaline, with little or no distinct maculation ....**terryi** Kirkaldy.
Tegmina conspicuously blotched with brown or fuscous...16
16(15). Tegmina distinctly milky-white where not brown; granules along veins dark; apices of femora yellowish or brownish; median frontal carina sharply and strongly elevated throughout and distinctly protuberant over fronto-vertex angle as seen from above; Hawaii...... .... **gulicki** (Muir).
Tegmina not conspicuously milky-white where not brown; granules along veins pale; apices of femora partly red, or the color of boiled lobster; median frontal carina comparatively low, not sharply elevated, especially low at angle between frons and vertex; Kauai........... .... **pluvialis** Kirkaldy.

Nesothoë antidesmae (Muir), new combination (fig. 51, i).
Nesodryas antidesmae Muir, 1917:300, pl. 5, fig. 2, 2a.

Endemic. Oahu (type locality: Nuuanu Pali).
Hostplant: *Antidesma platyphyllum.*

Nesothoë bobeae Kirkaldy (fig. 49, b).
Nesothoë bobeae Kirkaldy, 1908:204, fig. 2; 1910:593.
Nesodryas (*Nesothoë*) *bobeae* (Kirkaldy) Muir, 1916:177, pl. 2, fig. 14; pl. 3, fig. 61.

Endemic. Oahu (type locality: Mount Tantalus).
Hostplant: *Bobea.*
Perkins says in his letter that "Only one S.I.C. [Sandwich Islands Committee] example was found and it was labeled *'giffardi.'* Specimens of my own were labeled *bobeicola.*" The holotype male is now in the British Museum.

Nesothoë dodonaeae (Muir), new combination (fig. 51, d).
Nesodryas dodonaeae Muir, 1916:176, pl. 2, fig. 10; 1922:95.

Endemic. Kauai (type locality: Waimea).
Hostplants: *Alphitonia, Dodonaea, Myrsine* (*Suttonia*).
The carinae at the apex of the vertex and top of the face are obsolete.

Nesothoë dryope (Kirkaldy), new combination (fig. 51, b).
Nesodryas dryope Kirkaldy, 1910:597. Muir, 1916:176, pl. 2, fig. 11; pl. 3, fig. 62 (applies to this species ?).
Nesodryas (*Nesothoë*) *dryope* (Kirkaldy) Muir, 1917:301, misidentification.

Endemic. Kauai, Oahu (type locality: Mount Tantalus, 1,500 feet), (Hawaii?).
Hostplant: *Antidesma platyphyllum.*
I have examined two of the original examples from the type locality in Perkins' collection. These appear to me to belong to the group of slender species where Kirkaldy placed them, rather than to the stout *Nesothoë* group where the species was transferred by Muir. The female holotype is now in the Bishop Museum.
The specimens recorded by Muir under this name (1917:301) from *Antidesma platyphyllum* from Hawaii represent another species and were misidentified, in my opinion. Muir's figures must be checked with topotypical material, for it is possible that they represent another form.

Nesothoë elaeocarpi (Kirkaldy), new combination (fig. 51, c).
Nesodryas elaeocarpi Kirkaldy, 1908:103; 1910:596. Muir, 1916:175, pl. 2, fig. 8; pl. 3, fig. 57.

Endemic. Oahu (type locality: Mount Tantalus, 1,500 feet).
Hostplants: *Cyrtandra paludosa, Elaeocarpus bifidus, Scaevola mollis.*
The holotype female is now in the Bishop Museum.

Nesothoë eugeniae (Kirkaldy), new combination (figs. 50, d; 51, l, p).
Nesodryas eugeniac Kirkaldy, 1908:203; 1910:597. Muir, 1916:175, pl. 2, fig. 9; pl. 3, fig. 60.

Endemic. Oahu (type locality: "Honolulu Mts. 1500 ft." [Mount Tantalus ?]), Lanai.
Hostplants: *Eugenia sandwicensis, Straussia kaduana.*
The female holotype is in the British Museum.

Nesothoë fletus Kirkaldy (figs. 47, c; 49, a).
Nesothoë fletus Kirkaldy, 1908:204; 1910:592.
Nesodryas (*Nesothoë*) *fletus* (Kirkaldy) Muir, 1916:176, pl. 2, fig. 12; pl. 3, fig. 58; 1917:302; 1919:87. Genotype.

Endemic. Lanai, Maui (type locality: Iao Valley).
Hostplants: *Antidesma platyphyllum, Myrsine* (*Suttonia*).
This is a large, strikingly marked species whose tegminal color pattern is clearly apparent to the unaided eyes.
The holotype female is in the British Museum.

Nesothoë frigidula Kirkaldy (fig. 49, e).
Nesothoë frigidula Kirkaldy, 1908:204; 1910:593.
Nesodryas (*Nesothoë*) *frigidula* (Kirkaldy) Muir, 1916:178.

Endemic. Hawaii (type locality: Kona, 2,000 feet).

Perkins, in his letter, states of the type: "the specimen was labeled '*konae*' but was determined by the locality, date and description. Of the two specimens one was much broken." The female holotype is in the British Museum.

Nesothoë giffardi (Kirkaldy), new combination (figs. 50, c; 51, e).
Nesodryas giffardi Kirkaldy, 1908:203; 1910:597. Muir, 1916:175, pl. 2, fig. 7; pl. 3, fig. 59.

Endemic. Oahu (type locality: "Honolulu Mts. 1500 ft." [Mount Tantalus ?]).

Hostplants: *Cyrtandra grandiflora, Touchardia latifolia* ("olona").

This form and *eugeniae* and *elaeocarpi* are all closely allied. The female type is in the British Museum.

Nesothoë gulicki (Muir), new combination (fig. 51, f–h).
Nesodryas (*Nesothoë*) *gulicki* Muir, 1916:177, pl. 2, fig. 13; 1917:301; 1919: 87–88.

Endemic. Oahu, Lanai (?), Hawaii (type locality: Kahuku lava flows, Kau, 1,800 feet).

Hostplants: *Euphorbia, Metrosideros, Osmanthus sandwicensis.*

Muir (1919:88) emended his original description of the aedeagus as follows: "The orifice is at the apex, from the left edge of the orifice arises a small spine, a little basad and slightly more ventrad is a larger spine expanded at the apex with some small projections on the expanded portion, basad of this and on the right side is a small spine curved distad and with a minute spine about the middle."

Nesothoë haa (Muir), new combination.
Nesodryas (*Nesothoë*) *haa* Muir, 1921:509, pl. 8, fig. 1.

Endemic. Hawaii (type locality: Olaa, 29 miles, 2,300 feet).

Hostplant: *Antidesma platyphyllum* ("haa").

Nesothoë hula Kirkaldy (fig. 49, i).
Nesothoë hula Kirkaldy, 1908:204; 1910:592.
Nesodryas (*Nesothoë*) *hula* (Kirkaldy), Muir, 1916:178; 1922:93, pl. 3, fig. 4.

Endemic. Kauai (type locality: "high plateau," 4,000 feet).

Hostplants: *Osmanthus sandwicensis, Pelea, Phyllostegia, Sideroxylon, Myrsine* (*Suttonia*).

The holotype male is in the British Museum.

Nesothoë laka Kirkaldy (figs. 49, d; 59, a, b).
Nesothoë laka Kirkaldy, 1908:204; 1910:594.
Nesodryas (*Nesothoë*) *laka* (Kirkaldy) Muir, 1916:178; 1919:87.

Endemic. Maui (type locality: Iao Valley).
Hostplant: *Sida.*

Perkins states in his letter that he has "no note against this; the type should be in the B.M." [British Museum]. Muir (1919:87) said that he had studied "One male, three females and two nymphs from ridge south of Iao Valley, Maui, 800 feet elevation (Bridwell, August, 1918) on *Sida.* These conform fairly well to Kirkaldy's description which was made from one female, and are the only specimens taken since the type." I have been unable to locate these specimens in Honolulu, but the slide containing the genitalia of the above-mentioned male is in Giffard's collection. I have sketched the aedeagus and a genital style from this slide. The holotype female is in the British Museum.

Nesothoë maculata (Muir), new combination (figs. 50, e; 51, j).
Nesodryas (*Nesothoë*) *maculata* Muir, 1916:177, pl. 2, fig. 15; 1917:302.

Endemic. Oahu, Lanai, Hawaii (type locality: although the text gives the Kahuku lava flows, Kau, 1,800 feet, as the locality, the holotype bears a "Kilauea" label).
Hostplants: *Diospyros* (*Maba*) *sandwicensis, D. hillebrandii, Metrosideros* (?), *Osmanthus sandwicensis.*

Nesothoë munroi (Muir), new combination (figs. 50, f; 51, n).
Nesodryas (*Nesothoë*) *munroi* Muir, 1917:303, pl. 5, fig. 6; 1919:87.

Endemic. Lanai (type locality: 2,000 feet), Hawaii.
Hostplant: *Dodonaea.*

Nesothoë perkinsi Kirkaldy (fig. 49, f).
Nesothoë perkinsi Kirkaldy, 1908:204; 1910:593.
Nesodryas (*Nesothoë*) *perkinsi* (Kirkaldy) Muir, 1916:178; 1922:94, pl. 3, fig. 6.

Endemic. Oahu (type locality: "Honolulu 2000 feet 31-X-1892" [Mount Tantalus region]).
Hostplants: *Clermontia kakeana, Metrosideros, Myrsine* (*Suttonia*).
The holotype female is in the British Museum.

Nesothoë piilani Kirkaldy (figs. 49, g; 51, k).
Nesothoë piilani Kirkaldy, 1908:204; 1910:594.
Nesodryas (*Nesothoë*) *piilani* (Kirkaldy) Muir, 1916:178, misspelled *pulani;* 1917:301, pl. 5, fig. 4.

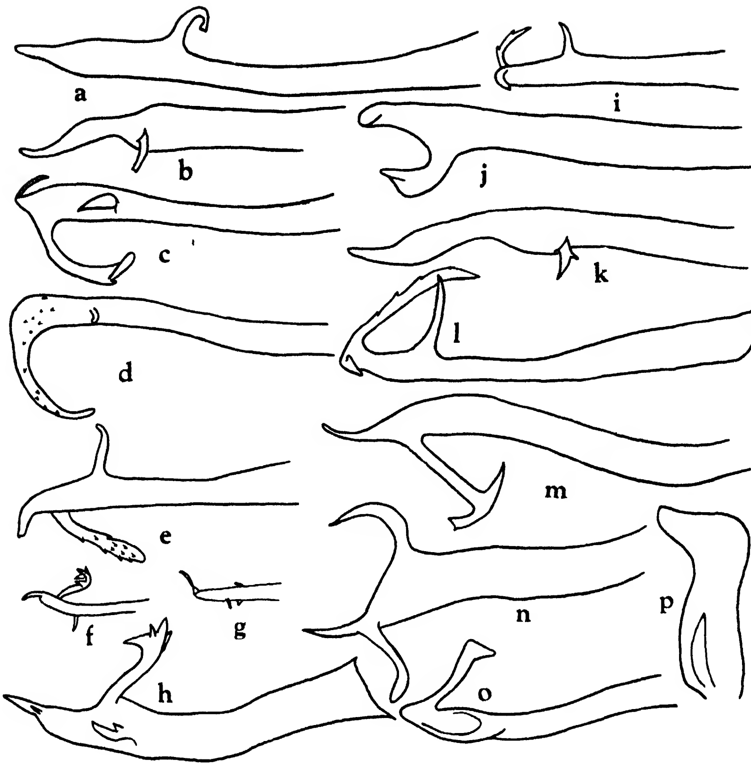

Figure 51—Genitalia of *Nesothoë* species (**p**, is a right style, the other figures are aedeagi; all except **f** and **g** are from balsam mounts): **a,** *N. terryi* Kirkaldy; **b,** *N. dryope* (Kirkaldy); **c,** *N. elaeocarpi* (Kirkaldy); **d,** *N. dodonaeae* (Muir); **e,** *N. giffardi* (Kirkaldy); **f, g,** two different views of the dry-mounted aedeagus of holotype of *N. gulicki* (Muir) to show differences of appearance when viewed from different angles; **h,** *N. gulicki* (Muir); **i,** *N. antidesmae* (Muir); **j,** *N. maculata* (Muir); **k,** *N. piilani* Kirkaldy; **l,** *N. eugeniae* (Kirkaldy); **m,** *N. seminigrofrons* (Muir), holotype (the anchor-like appendage may be broken at the tip); **n,** *N. munroi* (Muir), holotype; **o,** *N. pluvialis* Kirkaldy (from the type of *alboguttata* Muir); **p,** *N. eugeniae* (Kirkaldy), right style as seen from behind.

Endemic. Molokai (type locality: 3,000 feet), Lanai(?).

Hostplant: *Osmanthus sandwicensis* (Lanai examples).

Perkins gave no information in his letter regarding this species. The female holotype is in the British Museum.

The material used for this text came from Lanai. The unique female type has not been checked with this material and there may be two species involved here. See Muir's note (1917:302).

Nesothoë pluvialis Kirkaldy (figs. 49, h; 51, o).

Nesothoë pluvialis Kirkaldy, 1908:204; 1910:595.

Nesodryas (*Nesothoë*) *pluvialis* (Kirkaldy) Muir, 1916:178.

Nesodryas (*Nesothoë*) *alboguttata* Muir, 1922:94, pl. 3, fig. 7. New synonym.

Endemic. Kauai (type locality: Halemanu, 4,000 feet).
Hostplant: *Antidesma.*

The female holotype is in the British Museum. It was the only specimen of the species studied by Kirkaldy. Additional specimens collected by Perkins near Lihue were not seen by Kirkaldy, but the material was compared with the type by Perkins. It has been from the study of the latter examples and the unique holotype of Muir's *alboguttata* that I have established the above synonymy. Muir had never seen specimens which had been determined as *pluvialis,* and he did not know the species.

Nesothoë semialba (Muir), new combination.
Nesodryas (Nesothoë) semialba Muir, 1922:95, pl. 3, fig. 8.

Endemic. Kauai (type locality: Kalalau).
Hostplant: *Osmanthus sandwicensis.*

Nesothoë seminigrofrons (Muir), new combination (fig. 51, m).
Nesodryas (Nesothoë) seminigrofrons Muir, 1922:94, pl. 3, fig. 5.

Endemic. Kauai (type locality: "Kumuwela" [Kumuweia]).
Hostplant: *Campylotheca.*

This species is closely similar to *perkinsi,* and, if they are fully distinct species, the differences between them are not conspicuous.

Nesothoë silvestris Kirkaldy (fig. 50, a).
Nesothoë silvestris Kirkaldy, 1908:204; 1910:595.
Nesodryas (Nesothoë) silvestris (Kirkaldy) Muir, 1916:178.

Endemic. Lanai (type locality: Koele Mountains, 2,000 feet), Maui.

I have identified a single female from Waikamoi, Maui, taken at 4,500 feet by Muir, January 14, 1926, as this species—a new record for that island. The specimen is 6 mm. long and is one of the largest native Hawaiian delphacids I have seen. An example from Perkins' collection now before me was compared with the type by Perkins. The holotype female is in the British Museum. The elongate first antennal segment is unusual in this group.

Nesothoë terryi Kirkaldy (figs. 49, c; 51, a).
Nesothoë terryi Kirkaldy, 1908:204; 1910:594.
Nesodryas (Nesothoë) terryi (Kirkaldy) Muir, 1916:178; 1917:301, pl. 5, fig. 3.

Endemic. Oahu (type locality: Waialua district).
Hostplant: *Osmanthus sandwicensis.*

"Only two examples were found [in Kirkaldy's collection], one of these belonging to the S.I.C. [Sandwich Islands Committee] was labeled *'solitudinis,'* the other of later date captured by me." (Perkins' letter.) The female holotype is now in the British Museum.

Genus **NESODRYAS** Kirkaldy, 1908:203

Subgenus *Nesodryas* (Kirkaldy) Muir, 1916:170.

This genus was originally separated from *Nesothoë* because the included forms are "very slender, frail species," whereas those of *Nesothoë* are "robust forms." Muir (1916:170) stated that "The difference between *Nesodryas* and *Nesothoë* is, at most, only of sub-generic value; the type of the former (*N. freycinetiae*) is not typical of the other species, but is an extreme form, either divergent or convergent."

I had followed Muir's arrangement until the eve of going to press, when the study of a new species of *Nesodryas* taken by Dr. Swezey led me to examine the genitalia of the group in more detail. This examination has brought me to the conclusion that the types of *Nesodryas* and *Nesothoë* belong to different genera.

Typical *Nesothoë* are robust species with the wings conspicuously constricted at the base of the apical cells, as figure 47, c, of the genotype *N. fletus* plainly shows. However, there is a series of species which are slender, delicate forms rather superficially similar to the type of *Nesodryas* (*freycinetiae*) or approaching it more than *fletus*. All of these slender species have typical *Nesothoë* genitalia. On the other hand, *Nesodryas freycinetiae* has terminalia basically unlike those of any other described Hawaiian leafhopper genus. Therefore, I propose to place all of the slender forms now included in *Nesodryas* (excepting its type *freycinetiae*) in *Nesothoë* and retain *Nesodryas* for the species whose terminalia fit the basic pattern of *freycinetiae*. The discovery of a second species of the *freycinetiae* type gives weight to this decision.

The terminalia of both male and female *Nesodryas* are distinctive. Both are remarkable because they appear to have two anal styles instead of the normal one. The diagrams show this plainly. The lower anal style of the female is very large and conspicuous (about 0.5 mm. on the species at hand). The females of the genera in question can be separated easily on the basis of this character. The male pygophore of *Nesodryas* has a long upcurved spine at about the middle of each side margin and there is a pair of long, slender, spine-like processes arising behind the genital styles (thus forming what appear to be four genital styles). The aedeagus is a rather stout, decurved organ quite unlike the long, more or less rod-like aedeagus of *Nesothoë*. These characters may best be appreciated by examining the drawings.

Nesodryas, as here redefined, will include our Alohini which have the first antennal segment transverse, a single median frontal carina and terminalia of the basic type just described. The species are macropterous. The genus is a divergent development of the *Leialoha–Nesothoë* complex.

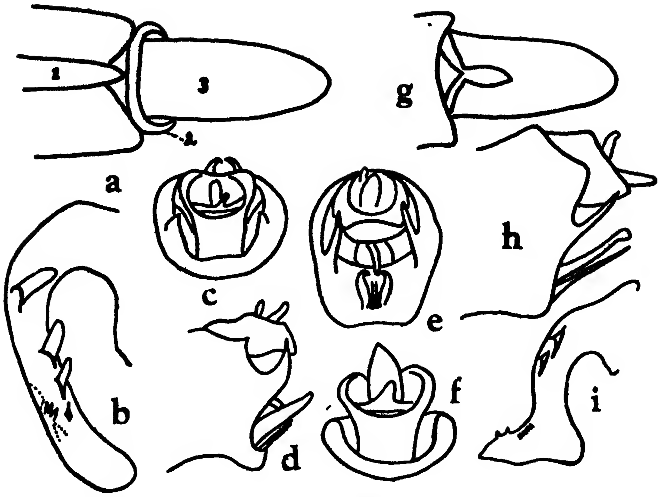

Figure 52—Details of genitalia of *Nesodryas*. **a–e,** *N. freycinetiae* Kirkaldy: **(a)** apex of female abdomen as seen from below, (1) ovipositor, (2) anal segment, (3) anal style; **(b)** aedeagus; **(c)** pygophore as seen from directly above; **(d)** side view of pygophore; **(e)** rear view of pygophore. **f–i,** *N. swezeyi* Zimmerman, new species: **(f, g)** dorsal views of apex of abdomen of male and female as seen from above, note the two anal styles; **(h)** side view of pygophore; **(i)** aedeagus.

Key to the Species of Nesodryas

1. Oahu species from *Freycinetia;* vertex of head and pronotum each with two conspicuous black spots; tegmina not striped with brown; male pygophore and genitalia as in figure 52, a–e .... **freycinetiae** Kirkaldy.
2. Hawaii species from *Pritchardia* palm; head and pronotum immaculate; tegmina with conspicuous brown vittae; male pygophore and genitalia as in figure 52, f–i............. .... **swezeyi** Zimmerman.

Nesodryas freycinetiae Kirkaldy (figs. 47, b; 50, b; 52, a–e).

Nesodryas freycinetiae Kirkaldy, 1908:203; 1910:596. Muir, 1916:175, pl. 2, fig. 16. Genotype.

Endemic. Oahu (type locality: Pacific Heights Ridge, Honolulu).

Hostplant: *Freycinetia arborea.*

Muir (1916:175) said when he included this species with those now placed in *Nesothoë,* "Unfortunately Kirkaldy chose this extreme form as the type of the genus; both in general build and in genitalia it departs from the other species very considerably." One might wonder why he did not separate the genera at that time.

The small but outstanding spots on the vertex and pronotum are rather surprising distinctive marks.

Swezey (1908:13–14) has reported on the life history of this interesting leaf-hopper. He notes that

> This is a delicate pale green little leaf-hopper living on the "ieie" vine.... The eggs are inserted in the younger leaves at the crown of the growing vine, parallel with the fibers of the leaves, one or two together. The young nymphs are very flat, adapted to crawling between the leaves in the crown of the plant. They also may be found exposed on the surfaces of the outer parts of the leaves, where they might not be recognized as young leaf-hoppers at first sight, on account of their flatness; and their coloration... allows them to be mistaken for a bit of dirt or debris.

His paper should be consulted for a description of the nymphs.

The female type is in the British Museum.

Figure 53—*Nesodryas swezeyi* Zimmerman, male paratype.

Nesodryas swezeyi, new species (figs. 52, f–i; 53).

Pale green or yellowish-green throughout except for the brown ovipositor and the following brown marks on fore wings: conspicuous narrow brown vittae down each membrane between veins of clavus and corium excepting the costal cell, and the mark may be pale or absent in the cell made by the forking of the vein above the costa; a short fascia across bases of anal cells just beyond apex of corium; veins of anal cell-complex each darkened distad and the membrane darkened along them in such a way as to make it appear that the veins expand apically, thus forming six dark lines in the apical cell area; veins in both pairs of wings otherwise pale; membrane of both pairs clear or only faintly tinged milky, but fore pair more yellowish or green basad; granules on fore-wing veins pale, giving rise to long, fine, pale hairs.

Face pale, unmarked and without callosities, derm appearing thin and transluscent; vertex obtusely pointed in front as seen from above, but median carina not protuberant.

Pygophore, its appendages and aedeagus as in figure 52, f–i.

Length: 5–6 mm. from front of head to apex of tegmina; breadth across hind margin of pronotum: 0.8–0.9 mm.

Endemic. Hawaii. Holotype male, allotype female and one female paratype taken from the leaves of *Pritchardia* palm on the Kulani Prison road, May 29, 1947, by O. H. Swezey. The types are in the Bishop Museum.

This species is closely allied to *freycinetiae,* but there are excellent characters to separate the two species. The vittae on the basal part of the tegmina are conspicuous and can be seen with the naked eyes or under low magnification. The male terminalia are closely similar in general type to those of *freycinetiae,* but they display good specific characters. The aedeagus is quite different, the spines below the anal styles are nearly as long as the styles, but they are only about one-half as long on *freycinetiae.* The sketches reveal these and other differences. Neither this species nor *freycinetiae* has anal spines.

It gives me the greatest of pleasure to dedicate this fine species to my close friend and colleague, Dr. O. H. Swezey, who collected it during a field trip on the eve of his seventy-eighth birthday.

Genus ALOHA Kirkaldy, 1904:177

This endemic genus is distinguished from its associated genera as follows: first antennal segment longer than broad; frons with two median carinae (sometimes low, poorly developed and obscure); tegmina extending beyond the middle of the abdomen, but macropterous in only a few known females.

The species originally assigned by Kirkaldy to the subgenus *Leialoha* of *Aloha* have been subsequently assigned to the full genus *Leialoha,* and some of the species described under *Nesopleias* have been included in *Aloha.*

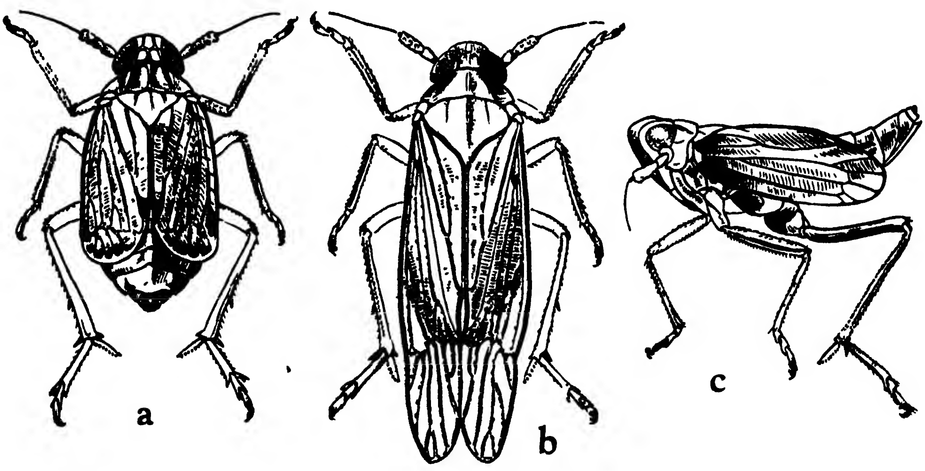

Figure 54—a, *Aloha ipomoeae* Kirkaldy, brachypterous female; b, the same, macropterous female; c, *Aloha flavocollaris* Muir, brachypterous female. (Drawn to same scale by Abernathy.)

Key to the Species of Aloha
(Male specimens)

1. Frons almost entirely black, with a yellow apical band and usually with a variable amount of brown from about middle of eyes dorsad, but pronotum not strikingly pale and tegmina not extensively dark.. **myoporicola** Kirkaldy.
   Frons either largely pale, or if dark, then pronotum markedly pale and tegmina with extensive dark areas......... 2

2(1). Face very dark but apically pale; pronotum sharply contrasting pale (yellow) with the dark mesonotum (nearly black); tegmina extensively dark........**flavocollaris** Muir.
   Not so, face pale.. 3

3(2). Tegmina each with a large, extensive, continuous dark macula.. 4
   Tegmina largely pale, with at most small or restricted dark areas.. 7

4(3). Pronotum and mesonotum dark brown or black; vertex comparatively short and broad, entire visible part of head as seen from directly above with median length from base to front slightly broader than long; tegmina reaching only to base of last abdominal segment.. **plectranthi** Muir.
   At least pronotum pale; vertex longer than broad; tegmina reaching nearly to or beyond apex of abdomen..... 5

5(4). Dark maculae of tegmina smaller, usually distinctly shorter than median length from mesonotum to front of head and widely separated from base of tegmina.. **campylothecae** Muir.
   Dark maculae of tegmina each longer than median length of body from apex of mesonotum to front of head, extending forward nearly to humerus at sides............ 6

6(5). Dark coloring of tegmina extending over apical cells to apex, tegmina thus pale only at base.. **artemisiae** (Kirkaldy).
   Tegmina pale at base and apex, dark coloring not extending over apical cells................**dubautiae** (Kirkaldy).

7(3). Head with interocular area appearing subquadrate or comparatively short and broad when viewed from directly above, its median length about one-tenth shorter than breadth of base of vertex..............**ipomoeae** Kirkaldy.
   Interocular area, as seen from above, longer than basal breadth of vertex.. 8

8(7). Tegmina with a dark mark at apex of clavus and apex of costal cell only; median facial keels fairly distinct and closer to each other than to lateral margins.. **swezeyi** Muir.
   Tegmina with dark maculae in apical cells and an irregular, dark, oblique fascia running from apex of clavus to reach costa at basal one-third; median facial keels obscure and separated from one another by a distance equal to or greater than that between one of them and lateral margin........................**kirkaldyi** Muir.

Aloha artemisiae (Kirkaldy).
Nesopleias artemisiae Kirkaldy, 1910:118.
Aloha artemisiae (Kirkaldy) Muir, 1916:182, pl. 2, fig. 27.

Endemic. Oahu (type locality: Waianae Mountains, 2,000 feet).
Hostplant: *Artemisia australis.*

Aloha campylothecae Muir.
Aloha campylothecae Muir, 1916:183, pl. 2, fig. 25; pl. 4, fig. 64.
Aloha kaalensis Muir, 1916:183, pl. 2, fig. 24 (type locality: Mount Kaala, Oahu). Synonymy by Muir, 1917:303.

Endemic. Oahu (type locality: Wailupe).
Hostplant: *Campylotheca.*

Aloha dubautiae (Kirkaldy).
Nesopleias dubautiae Kirkaldy, 1910:583.
Aloha dubautiae (Kirkaldy) Muir, 1916:182, pl. 2, fig. 26.

Endemic. Oahu (type locality: Mount Tantalus region).
Hostplants: *Dubautia laxa, Dubautia plantaginea.*
Perkins' notes regarding this species in his letter are as follows: "K[irkaldy] had no 1907 exx. of mine, unless they were destroyed when in his hands, but he may have read 1907 for 1902, here and elsewhere. I have no note of the type of this, but I certainly collected the sp. for the S.I.C., it being numerous in the Mts. behind Honolulu on the way up Konahuanui. The latest date I appear to have collected the sp. was early in 1906; in fact after this I only had one or two days collecting with Kershaw in Palolo and beyond on Olympus."

Aloha flavocollaris Muir (figs. 54, c; 56, h).
Aloha flavocollaris Muir, 1916:181, pl. 2, fig. 23.

Endemic. Oahu (type locality: Mount Kaala).
Hostplants: *Dubautia laxa, Dubautia plantaginea.*

Aloha ipomoeae Kirkaldy (figs. 46, c; 54, a, b).
Aloha ipomoeae Kirkaldy, 1904:177; 1908:205, pl. 4, fig. 9; 1910:581. Muir, 1916:178, pl. 2, fig. 17. Genotype.

Endemic. Kauai, Oahu (type locality: Mount Tantalus), Molokai, Lanai, Maui, Hawaii.
Hostplants: *Ipomoea batatas, I. bona-nox, I. insularis, I. pes-caprae, I. pentaphylla, I. tuberculata, Sesbania tomentosa* (accidental ?), *Scaevola coriacea* (accidental, I believe).

Parasite: *Paranagrus perforator* Perkins (Hymenoptera: Mymaridae; a purposely introduced species, although not brought in against this species) attacks the eggs.

An occasional macropterous female has been found.

The note in Perkins' letter regarding this species reads, "My note (when I corrected the proofs of K's paper in F. H. [*Fauna Hawaiiensis*]) says 'the original type of this species was in my specimens which are now in England. One card of these bears K's label *A. ipomoeae* but the word "type" is not used on any'."

Aloha kirkaldyi Muir.

Aloha kirkaldyi Muir, 1916:180, pl. 2, fig. 20; pl. 3, fig. 63.

Endemic. Oahu (type locality: Punaluu).

Hostplant: *Euphorbia hillebrandi.*

Aloha myoporicola Kirkaldy.

Aloha (?) *myoporicola* Kirkaldy, 1910:581.

Aloha myoporicola Kirkaldy, Muir, 1916: 179, pl. 2, fig. 18; 1917:303; 1921:510, pl. 8, fig. 8, corrected illustration.

Endemic. Lanai (?), Hawaii (type locality: Kilauea).

Hostplants: *Myoporum sandwicense, Pelea volcanicola, Phyllostegia racemosa* (accidental ?), *Acacia koa* (accidental ?).

The type should be in the British Museum, according to Perkins' letter.

Aloha plectranthi Muir.

Aloha plectranthi Muir, 1916:179, pl. 2, fig. 19.

Endemic. Oahu (type locality: Koko Crater).

Hostplant: *Plectranthus parviflorus* (series of examples have been reared from eggs inserted in the plants).

Aloha swezeyi Muir.

Aloha swezeyi Muir, 1916:180, pl. 2, fig. 21 (this figure erroneous ?; corrected by Muir, 1922:96, pl. 3, fig. 9); 1917:303.

Endemic. Kauai, Oahu (type locality: Palolo Valley), Hawaii.

Hostplants: *Bidens pilosa, Campylotheca macrocarpa, Cheirodendron gaudichaudii, Lipochaeta, Lythrum.*

This species was originally described and figured from Oahu specimens, but in his 1922 paper Muir reported on a series of examples from Kauai and stated that "The former figure of the aedeagus was incorrect, so a more correct one is given herewith." Could it be that his Kauai examples represent a form distinct from his Oahu specimens and that both figures are correct? This problem requires study.

Macropterous females have been found on Hawaii.

Genus NESORESTIAS Kirkaldy, 1908:205

Nesopleias Kirkaldy, 1910:582. Muir, 1915:265.

The Hawaiian Alohini having an elongate first antennal segment, two frontal carinae and abbreviated tegmina which do not reach beyond the middle of the abdomen are assigned to *Nesorestias,* a purely endemic group. The species resemble those of *Nothorestias,* but the presence of two frontal carinae will separate the two groups.

Muir (1916:184) considered *filicicola* to be an offshoot of the *ipomoeae* group of *Aloha* and *nimbata* an offshoot of the *kirkaldyi* group. As the genus is now constituted, it appears to be biphyletic. No long-winged forms are known.

Key to the Species of Nesorestias

1. Median frontal keels strongly elevated, continued dorsad onto vertex and causing profile of front of head, as seen from directly above, to have a median protuberance consisting of two keels and their interspace (as illustrated); tegmina with a black mark at apex of clavus and a fuscous streak extending from there obliquely to humerus. .**nimbata** (Kirkaldy).
2. Median frontal keels low and obscure, front of head as seen in profile from directly above convex and without such a protuberance (as illustrated); tegmina not so maculate.. .... **filicicola** Kirkaldy.

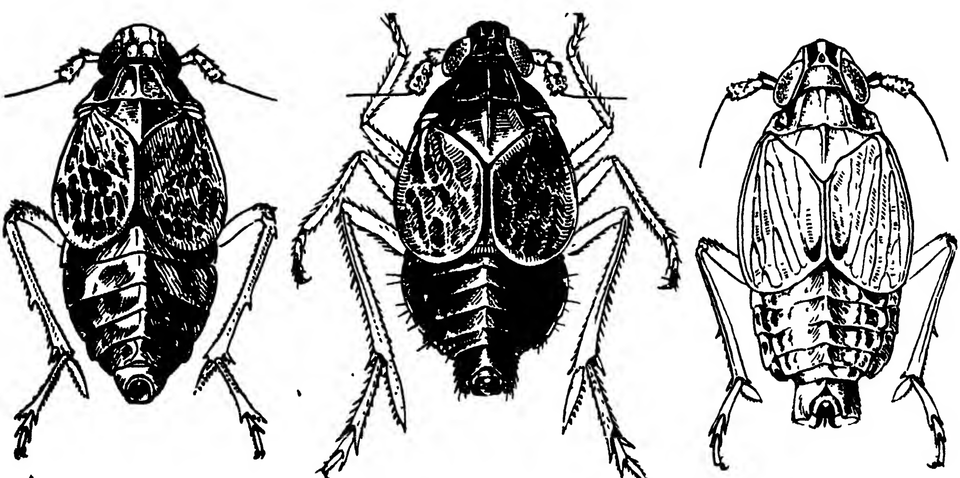

Figure 55—*Nesorestias filicicola* Kirkaldy, female, left; *Nothorestias swezeyi* Muir, male, center; *Kelisia eragrosticola* Muir, male, right. (Abernathy drawings; not to same scale.)

Nesorestias filicicola Kirkaldy (figs. 55; 56, e).

Nesorestias filicicola Kirkaldy, 1908:205; 1910:583. Muir, 1916:184, pl. 2, fig. 28; pl. 4, fig. 76. Genotype.

Endemic. Oahu (type locality: Mount Tantalus, 2,000 feet).

Hostplants: *Cibotium, Elaphoglossum gorgonum,* "ferns."

The type mount is now in the Bishop Museum and consists of a male and a female taken on fern in the "winter months" of 1902.

Nesorestias nimbata (Kirkaldy) (fig. 56, f).

Nesopleias nimbata Kirkaldy, 1910:582.

Nesorestias nimbata (Kirkaldy) Muir, 1916:184, pl. 2, fig. 29; pl. 4, fig. 77. (Genotype of *Nesopleias*).

Endemic. Oahu (type locality: Mount Tantalus, 1,500 feet).

Hostplant: *Phegopteris.*

Perkins notes in his letter that "The type must be the one in my coll.... labeled '*Aloha nephais*' (and without red label) and was taken in 1902 not 1907 (F.H.). If I afterward lent him [Kirkaldy] a 1907 specimen, I could not find it in his collection.... In the proofs of the F.H. at the end of the descript[ion] of genus the type of this is cited as *N. nephais,* but the species (1) is *N. nimbata,* (2) *dubautiae.* Consequently I deleted the 'Type *N. nephais*' as I could not find the species before the proofs had to be returned." The type is now in the Bishop Museum.

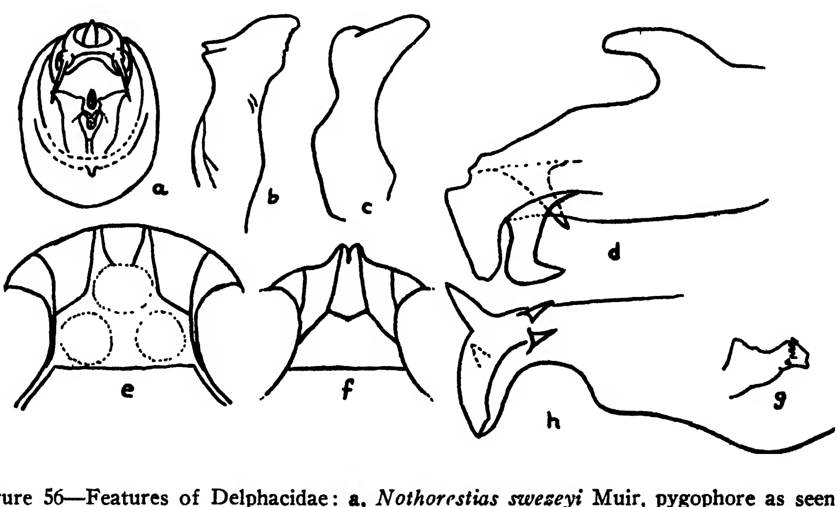

Figure 56—Features of Delphacidae: **a,** *Nothorestias swezeyi* Muir, pygophore as seen from behind (redrawn from Muir, 1922:87); **b,** right style of paratype of *Nothorestias swezeyi* Muir; **c,** *Nothorestias badia* Muir, right style of holotype; **d,** *Nothorestias badia* Muir, aedeagus of holotype; **e,** *Nesorestias filicicola* Kirkaldy, vertex from directly above to show frontal keels; **f,** the same of *Nesorestias nimbata* (Kirkaldy); **g,** *Nothorestias swezeyi* Muir, aedeagus (redrawn from Muir, 1922:87); **h,** *Aloha flavocollaris* Muir, aedeagus.

Genus NOTHORESTIAS Muir, 1917:304

This endemic segregate group has an elongate first antennal segment, a single frontal carina (which, on the two described species, forks at about or below the lower level of the eyes), and the tegmina are somewhat coriaceous, with the veins forming more or less of a reticulate pattern, and so abbreviated that they do not reach the middle of the abdomen.

As in *Nesorestias*, this genus is not monophyletic, but each of its species has been derived from a different species group. It is close to *Nesorestias*. Only two species have been described, and these from Oahu, but I have studied a single female of a new species from Maui.

Key to the Species of Nothorestias

(Males)

1. Underside of anal segment broadly arch-like, and with a long spine at each lateral corner; genital styles and aedeagus as in figure 56, a, b, g; lower apical margin of pygophore produced at the middle to form a triangular process (as seen obliquely from above) .... **swezeyi** Muir.
2. Anal segment without spines; aedeagus and genital styles as in figure 56, c, d. (Note: I have seen only the dissected holotype which is inadequate to supply more structural details of the pygophore for use here.) .... **badia** Muir.

Nothorestias badia Muir (fig. 56, c, d).

Nothorestias badia Muir, 1917:304, pl. 5, fig. 6. Genotype.

Endemic. Oahu (type locality: Kuliouou).

Hostplant: ferns.

The holotype is the only specimen known. It was taken in a different mountain range and at the opposite end of Oahu from the following species.

Nothorestias swezeyi Muir (figs. 55; 56, a, b, g).

Nothorestias swezeyi Muir, 1922:87, figs. 1, 2.

Endemic. Oahu (type locality: Makaha Valley).

Hostplant: *Aspidium* fern.

This species lives in the vicinity of leeward Mount Kaala and has been collected rarely in that area by sweeping ferns.

Genus DICTYOPHORODELPHAX Swezey, 1907:104

Of all of the remarkable endemic insect genera of Hawaii, this is one of the most extraordinary. It is fitting that it should have been discovered and described by one of the most eminent of all Hawaiian entomologists.

The species of this group have the front of the head tremendously prolonged into a great process which is longer than the remainder of the body in some species. This unique character causes the species to resemble such fulgorids as *Scolops*, rather than most delphacids. The genus is a peculiar local segregate of one of the *Nesorestias*- or *Nesosydne*-like groups. *Nesosydne leahi* shows a tendency toward the development of the cephalic horn. The genus has an elongate first antennal segment, a single, median frontal carina, and the tegmina extend only about to the middle, or to beyond the middle, or about to the apex of the abdomen. No macropterous forms are known. The frons of each species is pale, and the clypeus of each is black or nearly so. The head is prolonged in the nymphs, but not nearly to the extent that it is in the adults. The species feed on *Euphorbia*.

Kershaw (1913:185), who studied the internal anatomy of *D. mirabilis*, notes that the food reservoir of the alimentary canal "enters the head capsule and continues to the tip of the greatly produced epicranium. The malpighian tubes are forked distally for a moderate length, the forked part being lobulate, the rest smooth. They are pale brown."

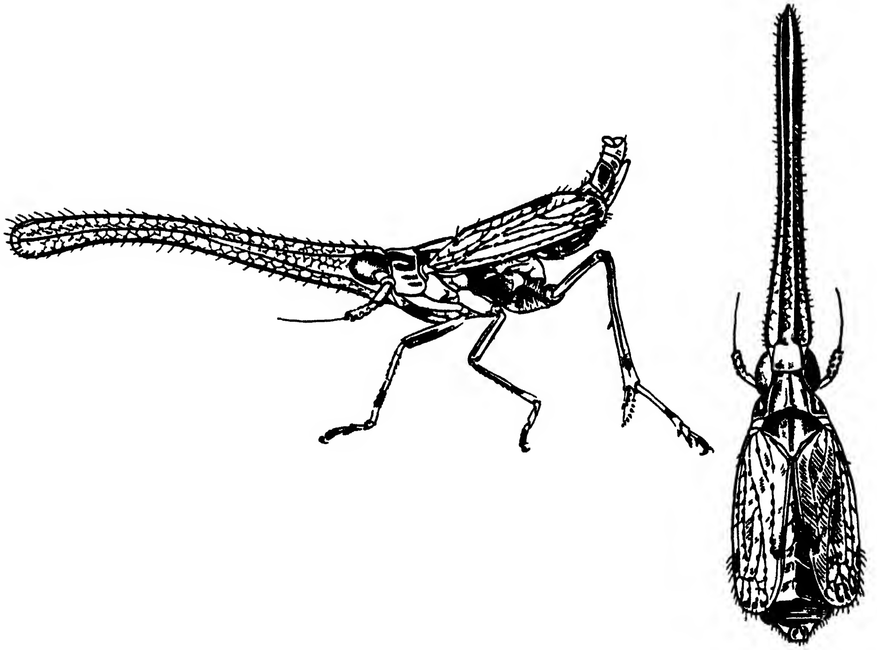

Figure 57—*Dictyophorodelphax mirabilis* Swezey, female. (Abernathy drawings to same scale.)

Figure 58—*Dictyophorodelphax* species: *D. swezeyi* Bridwell, male (Oahu), top; *D. usingeri* Swezey, paratype female (Lanai), center; *D. praedicta* Bridwell, female (Maui), bottom.

Key to the Species of Dictyophorodelphax

(Revised from Swezey, 1937:431)

1. Horn of head curved continuously upward from base to apex, its longitudinal dorsal outline concave; lateral carinae confluent at about middle; veins of tegmina with dark setigerous granules; Oahu.....**swezeyi** Bridwell.
   Horn of head curved forward or down apically, thus the longitudinal dorsal contour is convex.................. 2

2(1). Horn longer than remainder of body, not laterally compressed distad; lateral carinae confluent somewhat beyond middle; tegminal veins with dark setigerous granules; Oahu............................**mirabilis** Swezey.
   Horn not longer than remainder of body and laterally compressed distad................................... 3

3(2). Tegmina with dark setigerous granules; length of horn from anterior margin of an eye, as seen from side, equivalent to distance from hind edge of an eye to third abdominal tergite, or only slightly beyond apices of tegmina; Lanai...........................**usingeri** Swezey.
   Tegmina without dark setigerous granules; length of horn from anterior margin of an eye, as seen from side, equal to distance between hind margin of an eye and almost to, to, or slightly beyond apex of abdomen and far beyond apices of tegmina; Maui...............**praedicta** Bridwell.

Dictyophorodelphax mirabilis Swezey (fig. 57).

Dictyophorodelphax mirabilis Swezey, 1907:105; 1908:2, figs. 1–5. Muir, 1916: 184 (genitalia). Bridwell, 1917:279–280 (foodplant). Kershaw, 1913:185, (internal anatomy). Genotype.

Endemic. Oahu (type locality: Mount Konahuanui). It has been found on both mountain ranges on Oahu.

Hostplants: *Euphorbia clusiaefolia, Euphorbia hillebrandi*, (*Pittosporum glabratum*, accidental capture).

Parasite: an unidentified dryinid wasp.

The hairs on the sides of the horn are longer and more conspicuous on this than on the other species. Also, the horn is longer on this species.

Dictyophorodelphax praedicta Bridwell (figs. 58; 59, d, e).

Dictyophorodelphax praedicta Bridwell, 1919:72, fig. 1 (aedeagus).

Endemic. Maui (type locality: Iao Valley, 600–800 feet).

Hostplant: *Euphorbia hookeri integrifolia.*

Dictyophorodelphax swezeyi Bridwell (figs. 58; 59, c).

Dictyophorodelphax swezeyi Bridwell, 1918:386.

Endemic. Oahu (type locality: Wailupe).

Hostplant: *Euphorbia celastroides.*

The upcurved cephalic horn alone distinguishes this species from all the other known forms.

Dictyophorodelphax usingeri Swezey (fig. 58).

Dictyophorodelphax usingeri Swezey, 1937:431.

Endemic. Lanai (type locality: "trail to Lanaihale, 2000–3000 ft.").

Hostplant: *Euphorbia.*

This species most closely resembles *praedicta* from the adjacent island of Maui. It differs, however, by its shorter horn, dark setigerous granules on the tegmina and other characters. No males have been found.

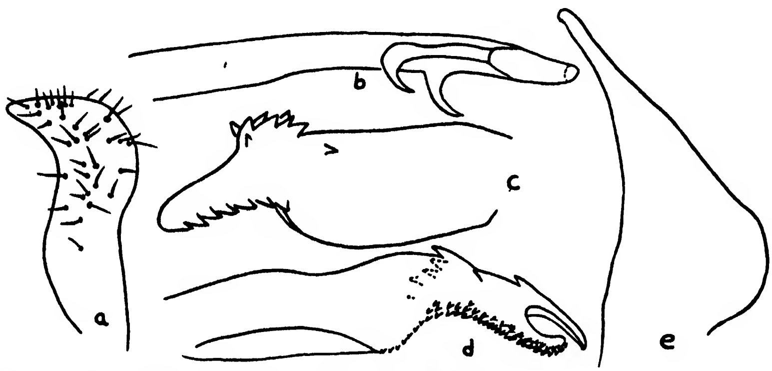

Figure 59—Some delphacid male genitalia: **a**, right style of *Nesothoë laka* Kirkaldy (?); **b**, apical part of aedeagus of *N. laka* Kirkaldy (?); **c**, aedeagus of *Dictyophorodelphax swezeyi* Bridwell; **d**, *Dictyophorodelphax praedicta* Bridwell, aedeagus; **e**, style of *D. praedicta* Bridwell.

Genus NESOSYDNE Kirkaldy, 1907:161

Ilburnia, in the sense of Muir, not of White, 1878.

This is the largest known genus of the Delphacidae of the world. It contains 82 described forms, all of them confined to the Hawaiian Islands. The next largest delphacid genus is the widespread, and probably composite, *Liburnia* which contains about 60 forms.

In the preliminary drafts of this work, I had followed Muir (1919:6; 1919:48) and subsequent workers in including our Hawaiian material in *Ilburnia.* This arrangement appeared to me unsatisfactory, because it was so unnatural. Further study has led me to consider Muir's sinking of *Nesosydne* under *Ilburnia* as untenable, and I have gone back to the use of *Nesosydne,* for the reasons outlined below.

After having worked on the Hawaiian delphacids for some time, Muir visited the British Museum to study the collection of Delphacidae there. He published his "Notes on the Delphacidae in the British Museum Collection" in January, 1919, and in that paper he stated that "*Ilburnia* White = *Nesosydne* Kirkaldy," without explanation. In June of 1919 his paper "On the Genus Ilburnia White" appeared in Honolulu, and in that paper he stated that there were no structural differences to use to separate the Hawaiian *Nesosydne* from the St. Helena genotype of *Ilburnia*. He redescribed *Ilburnia ignobilis* White (the genotype) from St. Helena (in the mid-South Atlantic), and transferred *Delphax simulans* Walker, which Darwin collected in the Galapagos, to *Ilburnia*. Later (1927:87), Muir described a species from the Marquesas and assigned it to *Ilburnia*. Thus, we came to have more than 80 species from Hawaii, one from the Marquesas, one from the Galapagos and one from St. Helena—a peculiar geographical distribution.

It is surprising to those who knew how insistent Muir was that no new delphacids be described from females alone, and how much emphasis he placed upon the male terminalia for information on relationships, to find that his assigning *Nesosydne* to *Ilburnia* was based upon only two female examples of *Ilburnia ignobilis* (one badly damaged). Muir's Marquesan species, likewise, was described from a unique female. The Galapagos species was represented by two males and a female. From this evidence I have felt that Muir was too hasty in his reduction of *Nesosydne*.

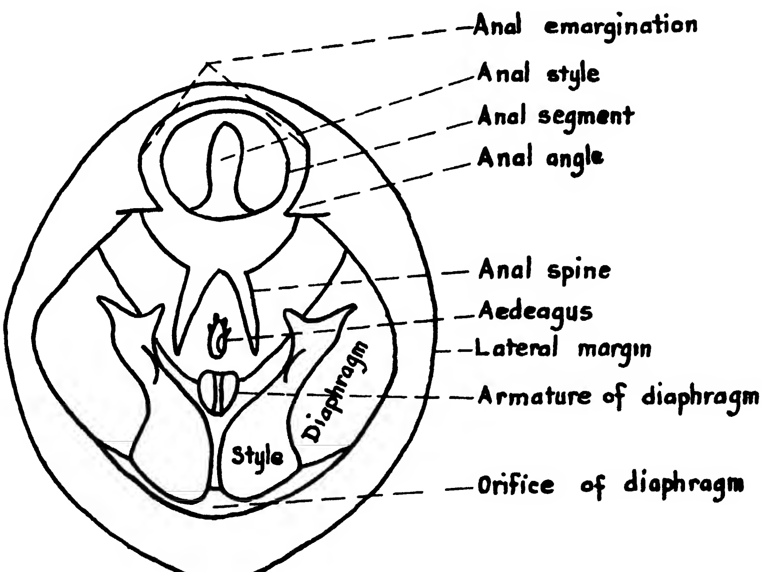

Figure 60—Diagram of rear view of pygophore of a hypothetical species of *Nesosydne* to show parts used in classification.

An outline of the problem was sent to W. E. China at the British Museum, and he has kindly examined the material at that institution. He writes that although he is not acquainted sufficiently with the group to pass final judgment on Muir's decision, "Judging by an examination of the type material of *Ilburnia* [*ig*]*nobilis* B. White from St. Helena, I should say that it is in error . . ." and

We have only 3 specimens of *I.* [*ig*]*nobilis* B. White in the B. M. collection including the type and these are all females. I do not think that Muir had other material of this species as St. Helena material is not very abundant. [Muir said that he had seen only two females: "the type is in good condition but the second specimen, which is smaller and darker and represents another species, is without tegmina."] It looks therefore as though he judged from the appearance of the females in the B. M. collection. I should say that *Ilburnia* is distinct from *Nesosydne*. Unfortunately the specimens we have of *I.* [*ig*]*nobilis* are all brachypterous and it is therefore difficult to judge, but the venation seems to be quite different. The antennae too have the first joint as long as the second.

The evidence at hand is, I believe, ample for retaining *Nesosydne* as a genus distinct from the Atlantic *Ilburnia*. Muir noted that the Galapagos species "is not quite typical," and I feel that it may belong to yet another genus. I have not seen identified specimens of Muir's Marquesan species, but it may be represented in the undetermined material before me. I believe that it may prove to be allied to the Hawaiian *Nesosydne* rather than to *Ilburnia*, or it may belong to a genus distinct from either.

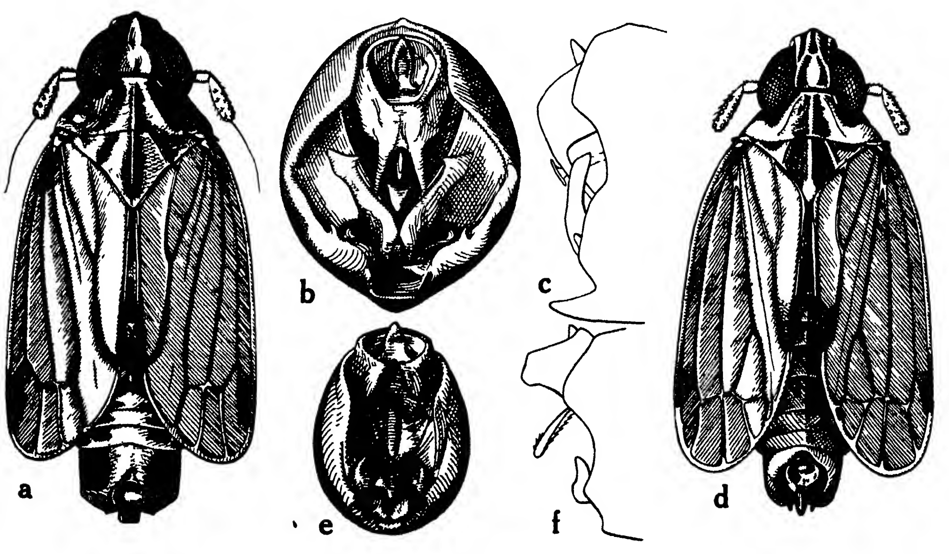

Figure 61—Holotypes of *Nesosydne*: **a**, *N. nubigena* Kirkaldy, male; **b**, rear view of pygophore of **a**; **c**, the same in lateral outline; **d**, *N. nephelias* Kirkaldy, male; **e**, rear view of pygophore of same; **f**, the same in lateral outline (the teeth on the aedeagus may not be drawn accurately, for they are hard to see and are difficult to interpret on dried specimens). (Drawn at the British Museum of Natural History by Smith.)

I have collected or examined undescribed species from southeastern Polynesia—Marquesas, Society, Austral and Mangareva Islands—which show much resemblance to the Hawaiian genera of Alohini. Some of them evidently belong to *Nesosydne,* perhaps some will be found to be isolated representatives of other Hawaiian genera, and others are localized offshoots which probably will be described as distinct new genera. Only further study will reveal the answers to these problems, but as now arranged, the geographical distribution of *Nesosydne* is more logical and falls in line with certain other genera of Polynesian organisms.

Nesosydne is separated from the other Hawaiian Alohini by the following combination of characters: first segment of antennae elongate (only slightly longer than broad in some species); frons with a single median carina (partly double in some forms); tegmina reaching nearly to, or surpassing, the apex of the abdomen in most species, but variable, the veins distinct. Most of these characters overlap one or more of the other local genera, and a combination of them may be essential to distinguish the genera which are not as clearly separated as the literature may appear to indicate. Macropterous males and/or females are known in about a dozen of the species. A few species are known only from macropterous specimens.

An adequate knowledge of this remarkable group can only be obtained by years of concentrated, careful study by a bio-systematist. Detailed field work is a prime

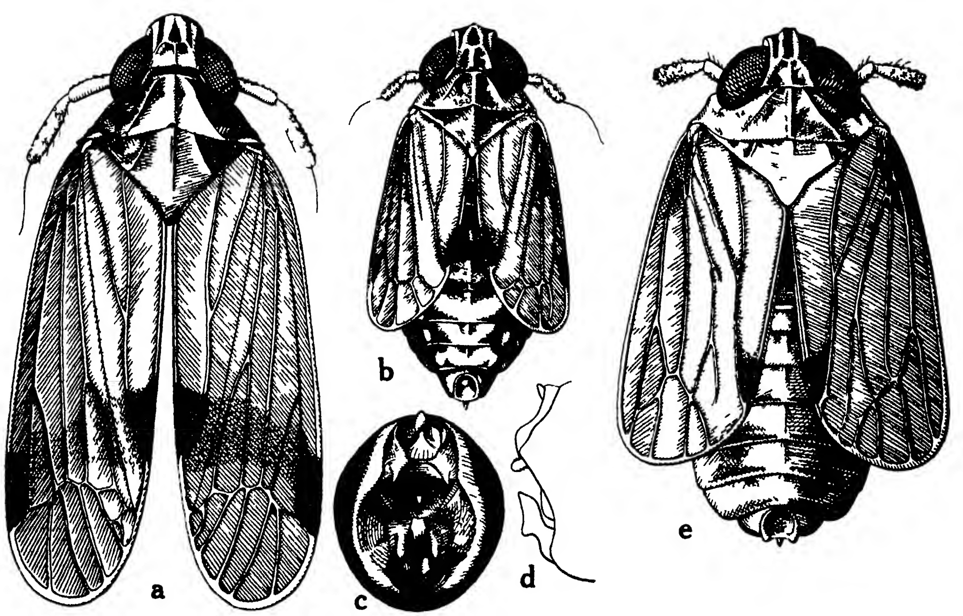

Figure 62—Holotypes of *Nesosydne*: **a,** *N procellaris* Kirkaldy, damaged female type; **b,** *N. imbricola* Kirkaldy, male; **c,** rear view of pygophore of same; **d,** lateral outline of same; **e,** *N. haleakala* Kirkaldy, female. (Drawn at the British Museum of Natural History by Smith.)

requisite. There are a number of groups of species within the genus which, when delimited by adequate diagnoses, could be described and keyed so that identification of undetermined material would be much simplified.

The formulation of a general key to the 82 species of *Nesosydne* has been a difficult task, and the outcome of my studies is not altogether satisfactory. I have used specimens determined by Kirkaldy, Perkins, Swezey and Giffard, but most of the material studied was determined by Muir, and types of most of the species have been examined. With the exception of the four Kirkaldy species listed below, specimens representing all the other species have been studied. However, a number of the species are represented by only one or two male types, many of which are dissected, and this lack of perfect individuals in series has been a serious stumbling block. Some of the species are variable, and certain characters at first considered useful for the key have had to be discarded. I fear that study will show that some of the characters used in the key as it now stands are not stable and further modification will be necessary. The females differ so much from the males, and so few females have been associated correctly with their males, that it has been impossible for me to include the females in the keys.

A key such as this is perfected only by repeated use and revision, and it should be used by a number of individuals to make it most useful and understandable. It is obvious that the few weeks devoted to its making are inadequate for such a complex task. I hesitate to present the key now, but I feel that in spite of its shortcomings it will facilitate the work of future students and will serve as a foundation for a more accurate and complete table for identification. The perfecting of the key remains a challenge for a keen and ambitious student of the Delphacidae.

The key should not be considered as a final course for identification, but only a tool with which generally to locate a species, which may then have to be studied in more detail and compared with the descriptions, illustrations or accurately identified specimens. Of course, many of the more outstanding species can be placed by the use of the key alone. Both categories of each dichotomy should be read carefully before a decision is made as to what course to follow. It must be borne in mind that the genus is a large and taxonomically difficult one, and it must be treated accordingly.

Because a number of species are represented in the male sex only by dissected individuals, it has been difficult to assemble characters of the pygophore which are obvious without dissection and which may appear distinctive on the perfect individuals. It appears rather puzzling to me that so many of the species are known from only one or a few type specimens, whereas it is common knowledge among experienced collectors that many species are frequently abundant on their hostplants. Specialized collecting should change the picture, however.

In spite of the large number of species now known, many remain to be described. No one has described a new species of *Nesosydne* since Muir published his last descriptions in 1922. I have examined a number of new species, but lack of time

prevents describing them. There may be more than 150 species living in Hawaii today, and it is probable that the number of species which have become extinct since the occupation of the islands by man is large.

Four species are not included in the following general key either because I have had no representatives of them, or because only females have been seen. However, the holotypes, which are in the British Museum, have been drawn, and these drawings included here will aid greatly in recognizing the species. I have been able to place some of the species in the geographical set of keys which follows the main key, however. I have not seen *nubigena* Kirkaldy. I have examined the female holotype of *hamadryas* Kirkaldy, one female of *procellaris* Kirkaldy, and two damaged females (?) of *haleakala* Kirkaldy.

Since the above notes and the main key were written, I have prepared a supplementary set of keys which contains a key to the species of each island. This second set of keys probably will prove to be more easily used than the long, complex main key. However, we do not have an accurate picture of the geographical distribution of all the species, and all of the keys must be used with care and caution.

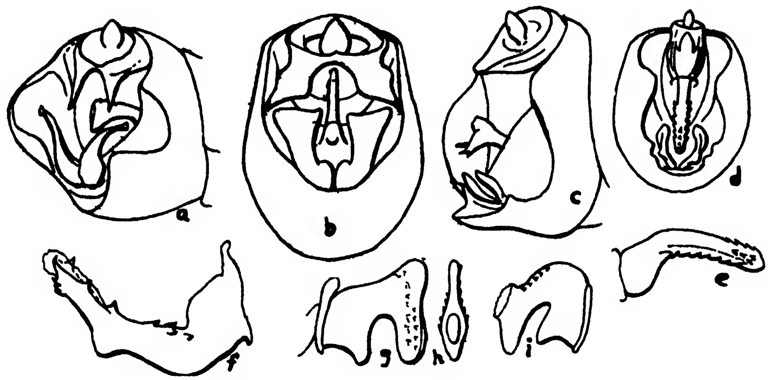

Figure 63—Details of *Nesosydne* genitalia: **a,** *N. koebelei* Muir, oblique view of pygophore; **b,** *N. nigriceps* Muir, pygophore from behind; **c,** *N. sola* Muir, oblique view of pygophore; **d,** *N. nephelias* Kirkaldy, rear view of pygophore; **e,** aedeagus of same; **f,** *N. asteliae* Muir, aedeagus; **g,** *N. nesogunnerae* Muir, lateral view of aedeagus; **h,** apical view of aedeagus of same; **i,** *N. gunnerae* Muir, aedeagus. (From Muir's original drawings.)

Key Section I: Provisional General Key to the Hawaiian Nesosydne

(Male specimens. See also the separate island keys on page 187.)

1. First antennal segment not more than twice as long as broad, either less than twice as long as broad or approximately twice as long as broad. (Note: The measurements were made with an eyepiece micrometer, viewing the insect from the front and measuring the length along the *dorsal* margin of the antennal segment and the breadth at the apex from the same view. These measurements usually cannot be guessed at, because of optical illusion, and must be made carefully.) 2

First antennal segment more than twice as long as broad, sometimes as much as three times as long as broad......58

2(1). First antennal segment comparatively short or very short for the genus, distinctly less than twice as long as broad, in some only about as long as broad (measure carefully) 3

First antennal segment approximately twice as long as broad (use caution here; if the segment is two-thirds as broad as long, it is *not* "approximately twice as long as broad," although it may appear to be so without measuring) 18

3(2). Median carina of frons forking below middle of face and thus double for most of its length..................... 4

Median carina of frons forking much nearer to vertex (or rather obscure and ill-defined, or both)............... 5

4(3). Vertex distinctly longer than broad, the median frontal carinae where they come into view from above at apex of vertex nearly fused and conspicuously protuberant; length about 2.5 mm.; a moderately elongate species.. .... **kokolau** (Muir).

Vertex broader than long and appearing unusually broad, median frontal carinae distinctly separated over fronto-vertex angle; length about 1.6 mm.; a short, stocky species............................**ahinahina** (Muir).

5(3). Face, including clypeus, entirely pale or nearly so, usually pale yellowish, at least without dark marks or dark vittae and not very brown.......................... 6

Frons and/or clypeus either largely dark, or with dark vittae or maculae on frons or clypeus or both, but never very pale overall, at least with darker coloration on clypeus, if not on frons. (Caution: Confusion may be caused at this point, for the character is not always stable. You may have to try each section, especially if you have a somewhat teneral individual.)...........41

6(5). Frons as viewed from directly in front with its top produced into a median protuberance as in figure 71, c, and elevated far above eyes; tegmina milky with conspicuous dark setigerous granules; on *Lipochaeta* on Oahu (and Kauai ?).......................**leahi** (Kirkaldy).

Not such species; top of frons as viewed from in front more as in figure 70, c............................. 7

7(6). Head as viewed from side with distance between fore edge of an eye and lateral facial carina nearly as great as, as great as, or slightly greater than, distance from carina to most remote point on profile of angle between frons and vertex, never less than one-half as great, as in figure 70, a.. 8

Head with distance between lateral facial carina and most remote point on angle between vertex and frons, as seen in profile as described above, obviously much greater than distance between fore edge of an eye and lateral carina, as in figure 74, c...........................16

8(7). Spines of anal segment fang-like or short and stout, thorn-like or dentiform, never very long, slender or needle-like 9
Anal spines very long, slender, needle-like............... 11

9(8). Tegmina conspicuously dotted with dark setigerous granules; genital styles broad and flat, hooked on outer sides at apices; median carina of frons strongly formed and elevated...................... **chambersi** Kirkaldy.
Tegmina without dark setigerous granules; genital styles long and slender; median frontal carina low and rather obscure, apparently forking near lower ocular margins... 10

10(9). Kauai form............................ **viridis** (Muir).
Hawaii form........................ **phyllostegiae** Muir.
(Note: These forms are very closely allied and the differences between them are difficult to define on the basis of the meager material available. See the drawings for differences found in the type series.)

11(8). (Note: Here belongs a difficult assemblage of forms attached to *Acacia koa* and which may be termed the *koae* complex. All of them have macropterous forms, and brachypterous forms are known only for *koae*. These species are separated best by the characters of the male genitalia and by their food habits. Some are more readily distinguished in the living state, because they have then more distinctive facies.)
Tegmina and wings milky hyaline (or yellowish ?); tegminal veins pale or white between granules, concolorous with membrane; granules dark and unusually conspicuous, for the dark color extends entirely across veins and encroaches slightly on membrane, thus giving a characteristic dotted appearance to tegmina.........
.... **koae-phyllodii** Muir.
Tegmina not so dotted, granules usually hardly if any darker than veins, but if distinctly darker, then dark color is confined to veins which are darker than membrane and are often brown......................... 12

12(11). Genital styles comparatively short and broad, broadly truncate at apex as in figure 77, c–e.................. 13
Genital styles elongate, as in figures 70, b, and 78, p........ 14

13(12). (Note: Two species were originally placed here. After the removal of one of them, I have not renumbered the entire key because of the great risk of error involved in such a process. Therefore, only one name is included here.) .... **pseudorubescens** Muir.

14(12). When viewed from above, inner basal angles of genital styles only slightly protuberant caudad; pale forms (green when living).................... **koae** Kirkaldy.
When viewed from above, inner basal angles of styles notably produced caudad to form distinct protuberances; comparatively dark forms................... 15

15(14). "...average color is a light reddish brown with lighter carinae" (Muir, 1916:185); aedeagus with a row of strong spines running from apex to base............
.... **rubescens** (Kirkaldy).

"The Kilauea, Hawaii, specimens are darker in color, especially the mesonotum of the males, which is sometimes nearly black, the anal spines are stouter and shorter, the dorsal row of spines on the aedeagus is represented by a few irregular spines...." (Muir, 1916:186) .... **rubescens pele** (Kirkaldy).

16(7). (Note: Three closely allied forms belong here, and they are difficult to separate.)
Maui form; genital styles as in figure 73, a; aedeagus elongate, as in figure 73, b .... **mauiensis** (Muir).
Hawaii forms; genital styles as in figures 74, a, and 77, f; aedeagus short and stout 17

17(16). Genital styles greatly prolonged at the "toe," as in figure 77, f .... **raillardiae** Kirkaldy.
Genital styles not so acutely pointed at the "toe," but as in figure 74, a .... **neoraillardiae** (Muir).

18(2). Pygophore with a conspicuous, tooth-like or stout, spine-like protuberance at middle of its lower caudal margin as in figure 65, d, h 19
Pygophore without such a ventral process 21

19(18). Vertex as seen from directly above with median line only slightly longer than its greatest basal breadth; anal segment transverse and with long converging anal spines; pygophore without hooks or lobes as in the two following species but with simple side margins... .... **amaumau** (Muir).
Vertex distinctly longer than broad; anal segment elongate, either without spines or with divergent spines 20

20(19). Sides of pygophore, as seen from behind, with a conspicuous, recurved, somewhat hook-like tooth on inner margin above medio-ventral spine, the latter long and pointed; genital styles short; anal segment without large spines and unusually produced apically so that it is about a third longer than wide .... **sola** Muir.
Sides of pygophore broadly lobate as illustrated; ventro-median spine rather short and blunt; genital styles long and extending up to the prominent spines on anal segment which is also somewhat elongate, but not so much as in *sola* .... **asteliae** Muir.

21(18). Apical margin of anal segment as viewed from directly above very deeply, broadly and unusually conspicuously emarginate, the emargination deeply V-shaped (fig. 66, i); armature on diaphragm of pygophore unusually large and protruding between and distinctly behind the styles which are formed as in figure 66, j.... .... **coprosmicola** (Muir).
Apical margin of anal segment as seen from above (*not* from below) entire or only inconspicuously notched, never formed as in *coprosmicola* even if emarginate; other characters mentioned not as in *coprosmicola* 22

22(21). Median frontal carina forking on face below vertex near lower level of eyes or farther distad, or, in *viridis* and

phyllostegiae, the carinae are vague and nearly obsolete and apparently fork below vertex....................23
Median frontal carina forking at or on vertex............30

23(22). Median frontal carina forking far down on face, near apex, double for most of length.....................24
Not such species, carina forking nearer lower level of eyes..26

24(23). Genital styles with their "toes" (or outer projection) bent cephalad, instead of laterad as usual, so that when viewed from side they appear bent forward at nearly right angles beyond middle as in figure 77, i.........
....**rocki** Muir.
Genital styles obviously not so formed................25

25(24). Pygophore very short, nearly vertical behind and mostly concealed from above; both "heel" (or inner projection) and "toe" of genital styles produced into a sharp, conspicuous projection (fig. 80, j)..................
................................**wailupensis** (Muir).
Pygophore not so formed; genital styles with their apical angles not projecting into slender points, but as in figure 76, j............................**painiu** (Muir).

26(23). Frontal carinae low and inconspicuous or in part difficult to trace completely, or both; armature of diaphragm of pygophore in form of a conspicuous, thin, vertical plate; genital styles as in figures 78, f, and 80, i.........27
Not such species....................................28

27(26). Kauai form............................**viridis** (Muir).
Hawaii form.........................**phyllostegiae** Muir.
(Note: These forms are closely allied and the differences between them are difficult to define on the basis of the meager material available. See the drawings for differences found in the type series.)

28(26). Pygophore shaped as in figure 82, f, in caudal view; genital styles long and slender; anal angles projecting partly around anal segment; tegmina reaching about to middle of abdomen.....................**giffardi** Muir.
Pygophore more open, genital styles shorter, anal angles not so produced and otherwise different from *giffardi;* tegmina extending about to apex of abdomen..........29

29(28). Pygophore in rear view as in figure 82, c, genital styles as in figure 78, d, aedeagus as in figure 82, h; anal spines not very large; Maui..............**perkinsi** Muir.
Pygophore not exactly like *perkinsi,* styles as in figure 74, i; aedeagus as in figures 63, g, h, and 74, j; anal spines large and blade-like; Lanai.................
................................**nesogunnerae** Muir.
(Note: These forms are closely allied, and the dissected holotypes at hand are inadequate material for proper treatment of the species herein.)

30(22). "Toe" (or outer projection) of each genital style unusually strongly produced laterally to form a long, heavy, broad projection as in figure 67, g (do not confuse the projecting "heel," or mesal part, with the ectal arm or "toe")..........................**cyrtandricola** Muir.

Genital styles not so formed, the "toe" never so greatly produced, although it is obviously produced in some forms, but never as in *cyrtandricola*..................31

31(30). Anal segment as viewed from behind distinctly concave and arch-like beneath, the concavity extending caudad and dorsad so that top of arch is hind margin of anal segment 32

Anal segment not so formed, entire beneath or nearly so, or concavity is so far forward as to be obscure in normal rear view and not extended to margin of anal segment 35

32(31). Genital styles with mesal-distal angles ("heels") strongly prolonged inward to form a long narrow point, as in figure 66, c........................**boehmeria** (Muir).

Genital styles with "heels" not so conspicuously more produced than "toes"..............................33

33(32). A line drawn between anal angles of pygophore passes through hind margin of anal segment or only slightly in front of it, and apical margin with or without a slight median emargination when viewed from directly above...33a

Such a line passes through about middle of anal segment, well in front of hind margin........................34

33a(33). Kauai species; inner edges of genital styles above basal swelling for most part straight, the common space between them not O-shaped; anal segment without a median emargination in hind edge; frons black only between carinae; pronotum and mesonotum with limited dark coloring................**campylothecae** (Muir).

Lanai species; inner edges of genital styles above basal swelling each concave so that the common space between them is sub-O-shaped; apical margin of anal segment with a small median notch, as seen from above; face, pronotum and mesonotum almost all black; tegmina with an extensive dark cloud........**nigriceps** Muir.

34(33). Armature of diaphragm of pygophore comparatively large and protruding outward to caudal level of genital styles so that "heels" of styles appear to rest on its apex...........................**stenogynicola** (Muir).

Armature of diaphragm smaller, less conspicuous and not protruding as mentioned above, but distant from genital styles.........................**dubautiae** (Muir).

35(31). Genital styles comparatively long and slender (fig. 69, o), comparatively narrowly exposed to caudal view; entire pygophore in caudal view distinctive as in figure 82, b .... **ipomoeicola** Kirkaldy.

Genital styles comparatively broad and flat, broadly exposed in caudal view, or if slender, then pygophore is conspicuously different in caudal view from that in *ipomoeicola*..36

36(35). Anal segment as viewed from above not extending caudad of a line drawn between apices of anal angles of pygophore, but enclosed by such a line...................37

Anal segment with its posterior end extending distinctly caudad of a line drawn between anal angles of pygophore 38

37(36). Inner apical angle of each genital style strongly produced inward to form a long and conspicuous point, as in figure 75, k; Oahu....................**oahuensis** Muir.
Inner apical angle of each style forming nearly a right angle and not produced inward, as in figure 70, n; Kauai ....**kuschei** (Muir).

38(36). Lanai species; aedeagus strongly barbed at apex to make it appear arrowhead-like or harpoon-like, or from side as in figure 69, e..........................**hamata** Muir.
(Note: I have seen only dissected specimens and entire individuals should have additional characters to use for separation from the following species.)
Aedeagus not so formed...............................39

39(38). Genital styles with inner edges of posterior faces on approximately same vertical plane from extreme base to apex, and when viewed from above there are seen to be no caudal projections from these inner edges, neither submedianly nor subbasally. (Note: If caution is not used in measuring the first antennal segment accurately, *naenae* will run here.)............ ..**acuta** (Muir).
Genital styles with inner edges of their posterior faces following an irregular vertical line, so that when they are viewed from directly above they are seen to be protuberant submedianly and subbasally.................40

40(39). Vertex distinctly widening apically and at its widest apical part (measured across carinae above, not down on sides in front of eyes where measurement would be obviously greater) slightly broader than at base..... ....**mamake** (Muir).
Vertex not widened distad, subequal or slightly narrower between lateral carinae at apex than at base......... ....**nesopele** (Muir).

41(5). Pygophore in anal view as in figure 82, b, styles arranged so as to suggest the shape of a lyre; aedeagus with a characteristic strong hook or tooth, as in figure 69, q .... **ipomoeicola** Kirkaldy.
Not so...42

42(41). Tegmina conspicuously spotted by comparatively large, dark, setigerous granules...........................43
Tegminal granules not large and dark and not giving a conspicuously spotted appearance to tegmina, or only partly dark and at most feebly spotted................45

43(42). Pygophore, as seen from behind, not obviously expanded at sides, but distinctly higher than broad; tegmina in some examples thick and entirely opaque........... ....**tetramolopii** (Muir).
Pygophore broadened laterally and about as broad as high; genital styles as in figures 66, a, h; 76, e.........44

44(43). Hawaii species; genital styles with apical margin sloping slightly downward and outward as in figure 66, h; aedeagus long and slender, as in figure 66, g...**chambersi** Kirkaldy.

Maui species; genital styles with apical margin sloping slightly upward and outward as in figure 66, a.........44a

44a(44). Aedeagus with apex broadly expanded as in figure 76, g.......................................**osborni** Muir.

Aedeagus slender, tapering to apex, not apically expanded..............................**bridwelli** (Muir).

45(42). Tegmina either distinctly bicolored, broadly pale from humerus diagonally across to black mark at apex of clavus, and pale across most of apical cell area, or at least broadly pale basad, or with infuscation hardly perceptible and membrane hyaline; spaces between carinae on frons very dark and sharply and conspicuously contrasting with pale keels.....................46

Without such a combination of characters; tegmina either largely opaque and with a rather granular texture, or more or less milky, or entirely dark or pale, or a combination of some of these characters.................51

46(45). Underside of anal segment broadly and conspicuously concave and arch-like, anal spine conspicuous but not unusually large; genital styles each with a blunt, tooth-like boss at about middle of inner margin as in figure 78, i–k............................**pilo** (Muir).

Underside of anal segment either not so broadly concave or entire, but if concave, then without such knobs on genital styles.......................................47

47(46). Underside of anal segment concave and with its sides strongly and heavily produced downward or spines unusually long and heavy; genital styles with "toes" obviously more strongly produced than "heels"...........48

Without such a combination of characters; "heels" of genital styles as much produced as, or more so than, "toes" 49

48(47). Lateral discal pronotal carinae curving slightly laterad at their apices and reaching or not reaching hind margin; pronotum and mesonotum almost entirely black; forks of median frontal carina low and almost obsolete on anterior part of vertex.............**raillardiicola** (Muir).

Lateral discal pronotal carinae extending directly to hind margin; forks of median frontal carina strongly elevated, pale and conspicuous on entire vertex.......................................**bridwelli** (Muir).

49(47). A line drawn between apices of anal angles of pygophore passes through hind margin of anal segment; anal spines (as seen in balsam mount) very long, slender and needle-like.......................**pipturi** Kirkaldy.

A line drawn between apices of anal angles of pygophore passes far anterior to apical margin of anal segment; anal spines not unusually long, slender or needle-like....50

50(49). Kauai species; aedeagus with a large, broad, flange-like subbasal tooth on lower right side as in figure 82, g. . . . . **naenae** (Muir).
Maui species; aedeagus without such a flange, as in figure 68, j. . . . . **geranii** (Muir).
51(45). Length of median keel of pronotum fully two-thirds as long as distance between hind ends of lateral pronotal discal keels. 52
Length of median keel of pronotum only about equal to distance along hind margin between apex of median keel and apex of a lateral discal keel. 54
52(51). Predominantly pale-yellowish species from Oahu; tegmina nearly twice as long as thorax and head together, anal cells distinct (I have examined only the mutilated type, and there should be characters on the pygophore of perfect examples which would offer good characters to separate this species from the following two). . . . . **incommoda** Muir.
Predominantly brown or dark species from Maui; tegmina very short, little if any longer than distance between apex of vertex and hind margin of mesonotum; anal cells obsolete. 53
53(52). Very dark, nearly black-bodied species; in side view the genital styles are widely exposed and project strongly out of pygophore as in figure 65, g. . . . . **argyroxiphii** Kirkaldy.
Nota of thorax, top of head and legs pale; genital styles not so broadly exposed in side view, and pygophore almost entirely withdrawn beneath last complete abdominal tergite and nearly entirely concealed from above. . . . . **eeke** (Muir).
54(51). Tegmina almost or entirely dark, never milky-white: Maui forms. 55
Tegmina milky-white or yellowish-brown (on *Styphelia*). . 56
55(54). Anal segment as seen from behind with its underside arch-like, each side of arch produced into a large, fang-like tooth; lateral discal pronotal carinae thickened, curved laterad and not reaching hind pronotal margin; on *Coprosma*. . . . . **monticola** Kirkaldy.
Anal segment entire beneath; lateral discal pronotal carinae evidently reaching hind margin and not apically curved outward toward sides; on *Styphelia* (*Cyathodes*) . . . . **nigrinervis** (Muir).
56(54). Frons brownish-yellow or yellowish, but with apex in part or entirely and broadly dark and there concolorous with dark clypeus; Hawaii form. . . . . . **cyathodis** Kirkaldy.
Frons vittate or nearly concolorous, but not apically fasciate. 57
57(56). Molokai species. . . . . **fullawayi** (Muir).
Lanai species. . . . . **lanaiensis** (Muir).
58(1). Anterior profile of vertex as viewed from directly above with median carina conspicuously protuberant, as in figure 69, j. 59

Anterior profile of vertex with median carina not so distinctly protuberant, more as in figure 69, k.............71

59(58). Profile of hind margin of pygophore, as seen from side, as in figure 76, 1, with medio-ventral angle drawn out into a very prominent spine, and with a smaller spine at about midway up side (this may be partly concealed by long setae and may be difficult to see in certain lights); anal segment with apical part broad and each side expanded into a very large tooth which extends downward and obliquely outward to submedian lateral tooth on side of pygophore; apices of genital styles expanded and bifid, reaching anal segment; high mountains of Molokai....................**palustris** Kirkaldy.

Not such species, even though medio-ventral angle of pygophore is protuberant and there is a tooth on side margin above it.................................60

60(59). Pygophore with ventro-median part produced into a very prominent spine and sides widely concave as viewed from side and enclosing anal segment in two prominent points which appear as in figure 76, a, when viewed from above..........................**olympica** (Muir).

Not so..61

61(60). Pygophore, as seen in profile from side, with hind margin as in figure 72, f, ventro-median angle produced to form a tooth-like process, and with a lateral, submedian tooth-like expansion (the former ventral process appearing pointed from the side, but when viewed from above it is blunt and rounded); anal segment with its ventro-lateral corners produced to form stout lobes as in figure 72, e.................**montis-tantalus** Muir.

Not so..62

62(61). Pygophore, as seen in profile from side, with a very large, broad, pointed tooth-like expansion as in figure 69, i; hind margin of anal segment turned caudad and downward at middle and there darker and more heavily sclerotized; genital styles narrow and horn-like, curving inwardly and tapering to points........**gunnerae** Muir.

Pygophore not so formed...........................63

63(62). Pygophore as seen in profile from side with a large lobe-like expansion as in figure 69, a (genital styles partly twisted or otherwise placed so that their narrowest edges largely are presented to view from directly behind and their apices are subcontiguous or rather close together)..64

Pygophore not so formed, or if with a rather similar lobe-like expansion, then with apices of slender genital styles turned outward and assuming a sort of lyre-shape (as in fig. 63, a, of *koebelei*), or otherwise different......65

64(63). Tegmina leaving last two abdominal tergites plus pygophore exposed; length about 4.5 mm......**gigantea** (Muir).

Tegmina reaching nearly to apex of abdomen; length less than 4 mm.......................**neowailupensis** (Muir).

(Note: These two forms appear to be close allies and additional specimens should be studied to ascertain their proper relationships.)

65(63). Pygophore as in figure 82, e (I am not sure that this species belongs to this section, try also at 71.)........ ....**cyrtandrae** Muir.

Not so...66

66(65). Pygophore crimped inward at edges toward apex of anal segment (fig. 68, l); anal segment unusually elongate, with its hind margin heavily thickened, strongly produced, and not bearing teeth, and as in figure 68, k ....**gouldiae** Kirkaldy.

Pygophore not crimped in at hind edges of anal segment; anal segment not thickened and produced posteriorly, armed with a large, flange-like or fang-like tooth on each side in all species except *timberlakei*..............67

67(66). Anal segment without spines; genital styles as seen in broadest view as in figure 79, l; aedeagus as in figure 79, k (I have seen only the dissected holotype); Oahu. .... **timberlakei** Muir.

Anal segment with well-developed spines................68

68(67). Pygophore, in profile as viewed from side, with a prominent, lobe-like protuberance as in figure 77, m, of *sharpi*, or if not the same, then as in figure 63, a, of *koebelei* 69

Pygophore not so shaped.............................70

69(68). Genital styles slender, as in figure 77, l, as seen from side ....**sharpi** Muir.

Genital styles broad and somewhat scythe-shaped as seen from side, as in figure 70, j................**koebelei** Muir.

70(68). Pale-yellow species from Maui with tegmina dark only at apices of clavus and costal cell; aedeagus of unusual form, as in figure 79, d; genital styles apically truncate with the angles slightly projecting. (Note: I have not seen an entire example of this species.).... ....**sulcata** (Muir).

Yellowish-brown species from Oahu with tegmina extensively fuliginous; genital styles acuminate and with a basal tooth-like process which is best seen from side ....**lobeliae** Muir.

71(58). Anal angles of pygophore conspicuously produced into strong, pointed processes which largely surround anal segment and project unusually far behind its caudal margin (curved inward and downward as seen from behind); armature of diaphragm very long, nearly as long as inner side of a style beyond its basal angulation; pygophore and appendages in anal and dorsal views as illustrated. (Note: I have seen allied, similar-appearing new species from the type locality of this species and taken with it.)..............**waikamoiensis** (Muir).

Not so...72

72(71). *Pygophore as in figure 72, a, with anal angles produced to form apically rounded processes which nearly meet on median line and nearly enclose anal segment.......................................**longipes** (Muir).*
Pygophore not so formed.................................*73*

73(72). *Pygophore, in lateral profile, with a large, conspicuous, submedian concavity in hind margin as in figure 72, j, of* ***nephelias*** *or as in figure 64, a, of* ***aku***...............*74*
Pygophore not so shaped; if concave, then not as deeply so and without such a contour......................*76*

74(73). Pygophore as in figure 82, e; genital styles with a tooth-like lobe on inner side toward apex as in figures 67, c, and 82, e...........................**cyrtandrae** Muir.
Pygophore obviously different; genital styles without such a process so placed, if a lobe is present (*nephelias*), it is placed distinctly lower down and apices of styles are obviously differently shaped.....................75

75(74). Pygophore, in full rear view, obviously distinctly broader on a line drawn through bases of genital styles than median height from same line to top of anal segment ....**aku** (Muir).
The pygophore very much narrower than high at above-mentioned point......................**nephelias** Kirkaldy.

76(73). A very large, robust species from highlands of Molokai, about 4.5 mm. long.................**procellaris** Kirkaldy.
Not so..77

77(76). Underside of anal segment conspicuously concave, arch-like; genital styles short; pygophore as in figure 62, c, d ....**imbricola** Kirkaldy
Underside of anal segment not arch-like...............78

78(77). Pygophore in lateral profile with submedian part of hind (lateral) margin concave, as in figure 74, d, or rather similar, more deeply concave in some species...........79
Pygophore with hind margin in profile not partly concave as stated above...... 81

79(78). Large species, 4 mm. or longer; each genital style with a small protuberance at its inner edge near base, which when viewed from above is stoutly spine-shaped...... ....**ulehihi** (Muir).
Smaller species, about 2 to 3 mm. long; genital styles without such processes............................80

80(79). Vertex about as broad as long; genital styles long, large and heavy, extending up to level of anal segment..... ....**nephrolepidis** Kirkaldy.
Vertex nearly twice as long as broad; genital styles comparatively short and stocky, their apices remote from anal segment...........................**anceps** Muir.

81(78). Pygophore as viewed from directly behind as in figure 82, a; aedeagus shaped like an arrowhead and very distinctive; ventral, caudal margin of pygophore with a blunt, median protuberance.............**halia** Kirkaldy.
Without such characters.............................82

82(81). Anal segment transverse (fig. 80, f); a line drawn between apices of adjacent enclosing parts of pygophore (anal angles), as viewed from above, passes behind apex of anal segment; genital styles comparatively broad throughout........................**umbratica** Kirkaldy.

Anal segment longer than broad; a line drawn between apices of adjacent enclosing parts of pygophore, as viewed from above, passing in front (cephalad) of hind margin of anal segment; genital styles broad or slender in caudal view.............................83

83(82). Pygophore in full rear view as in figure 82, d; genital styles broad; Oahu......................**swezeyi** Muir.

Pygophore not so formed; genital styles slender in caudal view; Maui.....................**neocyrtandrae** (Muir).

Section ii: Keys to the Species of Each Island

KEY TO THE KAUAI NESOSYDNE

(Males. Nine species.)

1. Vertex of head strongly produced, distance between fore edge of an eye and apex is half or more than half as long as an eye when measured from side; tegmina milky with conspicuous dark granules on veins; male genital styles broad and flat; anal segment emarginate distad.............................. **leahi** (Kirkaldy).

Vertex not so produced, less than one-half as long as an eye as measured from side.......................... 2

2(1). Median carinae of head conspicuously protuberant as viewed from directly above and obviously discontinuous with sides of apex of vertex, more as in figure 69, j, than in 69, k.... 3

Median carinae low and inconspicuous on vertex as seen from above, apex of vertex broadly rounded (do not be confused into believing median line is protuberant by differences in color of median line and adjacent areas of vertex, observe anterior silhouette only)...... 4

3(2). Anal segment with prominent, divergent spines which have broad, semimembranous expansions and appear in rear view as in figure 66, f (spines extending down over tops of genital styles in holotype)... ....**campylothecae** (Muir).

Anal spines small, close together, obscure, not ordinarily visible from behind......... ....**kuschei** (Muir).

4(2). Face vittate, black between pale median and lateral carinae. 5

Face pale, not vittate............................... 6

5(4). Pygophore and genitalia in rear view of a characteristic shape as in figure 82, b, as broad or broader than high; styles slender, widely separated, inner apical angles about twice as broadly separated as breadth of apex of a style.........................**ipomoeicola** Kirkaldy.

Pygophore of different shape, higher than broad; styles broad, their inner apical angles only as widely separated as breadth of apex of a style.............**naenae** (Muir).

6(4). Anal spines broad, stout, tooth-like; usually brachypterous................................**viridis** (Muir).

Anal spines long, slender, needle-like; usually macropterous 7

7(6). Tegmina with a characteristic, prominent dotting formed by unusually conspicuous dark granules on pale veins, dark color extending entirely across veins and slightly encroaching on membrane...........**koae-phyllodii** Muir.

Tegmina not so spotted, granules hardly if any darker than veins, but if distinctly darker, then dark color is confined to veins which are darker than membrane and are often brown.................................... 8

8(7). Inner basal angles of genital styles, as seen from above, only slightly produced caudad; pale forms (green when living) ....**koae** Kirkaldy.

Inner basal angles of genital styles distinctly produced into caudal knob-like protuberances (best seen obliquely from above); comparatively dark forms (reddish-brown or darker)............**rubescens** (Kirkaldy).

KEY TO THE OAHU NESOSYDNE

(Males. Twenty-nine species; *N. hamadryas* omitted.)

1. Ventral, caudal margin of pygophore with a conspicuous median protuberance (usually sub-spiniform).......... 2

Pygophore without any median protuberance on lower hind edge 7

2(1). Anal segment with hind angles produced to form stout, round-ended processes.............**montis-tantalus** Muir.

Hind angles of anal segment not so produced........... 3

3(2). As viewed from above, with pygophore produced into long pointed processes which extend around and far beyond apex of anal segment (fig. 76, a)........... .... **olympica** (Muir).

Sides of pygophore not so formed.................... 4

4(3). Anal segment with hind margin turned caudad and downward at middle and there darker and more heavily sclerotized, shallowly concave and not elongated caudad .... **gunnerae** Muir.

Anal segment not so formed, either produced caudad and more or less tongue-shaped, or normally rounded in shape 5

5(4). Anal segment normally rounded, not produced caudad, a line drawn between dorsal angles of pygophore passes at its hind edge (usual color pattern of males: generally pale species with contrasting dark pronotum and mesonotum and some dark maculae on tegmina usually most distinct at claval apices)................**halia** Kirkaldy.

Anal segment produced caudad and more or less tongue-shaped 6

6(5). Sides of pygophore, as seen from behind, with a conspicuous, recurved, somewhat hook-like tooth on inner margin above medio-ventral spine, the latter long and pointed; genital styles short; anal segment without large spines and unusually produced apically so that it is about one-third longer than broad. . . . . **sola** Muir.

Sides of pygophore broadly lobate as in figure 65, h, ventro-median spine rather short and blunt; genital styles long and extending up to the prominent anal spines. . . . . **asteliae** Muir.

7(1). Anterior edge of vertex, as viewed from directly above, evenly or subcontinuously convex, median carinae not or indistinctly protuberant and not obviously interrupting anterior outline. 8

Carinae, as they come into view over fore edge of vertex as seen from above, distinctly protuberant and distinctly interrupting anterior contour of vertex. 17

8(7). First antennal segment, measured along dorsal edge from front, longer than breadth of narrowest interocular part of frons as seen from front. 9

First antennal segment shorter to much shorter than breadth of narrowest interocular part of frons. 10

9(8). Anal (dorsal) angles of pygophore produced into distinct protuberances (as seen from above) which project distinctly behind caudal margin of anal segment, which is strongly transverse and has its hind margin only slightly arcuate, nearly subtruncate. . . . . **umbratica** Kirkaldy.

Anal angles of pygophore not produced; anal segment not transverse, its hind margin projecting caudad of dorsal angles of pygophore. . . . . **swezeyi** Muir.

10(8). Anal angles of pygophore, as seen from above, appearing to be produced into subtriangular protuberances which partially envelop anal segment, a line drawn between their hind edges passes through or slightly caudad of hind margin of anal segment (intercarinal areas of frons conspicuously dark; genital styles broad, and heel and toe each produced so that from some angles apex appears almost bifid; when viewed from side, pygophore very nearly hides all enclosed structures including styles). . . . . **oahuensis** Muir.

Anal angles of pygophore not so produced, or if slightly produced, then anal segment projects behind anal angles. . 11

11(10). Face conspicuously vittate in all species except *nephrolepidis,* but even in that species intercarinal areas are darker than carinae; genital styles either broadly expanded with inner apical angles well developed, or with inner apical angles more strongly produced than outer angles; never with combination of narrow genital styles and concolorous face. 12

Face nearly or quite concolorous and not vittate and not dark in all species except *ipomoeicola* which may have a distinctly vittate frons; genital styles in all species comparatively long and narrow and with inner apical angles at most moderately produced..................14

12(11). Pronotal keels dark; face at most vaguely vittate, never with carinae very pale with intercarinal areas black in sharp contrast; apices of genital styles broad and heavy, each with a small protuberance on inner margin below inner apical angle (best seen obliquely from above)........................**nephrolepidis** Kirkaldy.

Pronotal keels pale; face with keels pale and intercarinal spaces black, thus forming sharply contrasting vittae; genital styles not as described above..................13

13(12). Each genital style with inner apical angle strongly produced into a comparatively slender prolongation which is much longer than outer apical angle; on *Boehmeria* ....**boehmeria** (Muir).

Genital styles without such strongly prolonged inner apical angles, inner angles rather similar to outer apical angles; on *Pipturus*.................**pipturi** Kirkaldy.

14(11). First antennal segment about twice as long as broad; face usually vittate; pronotum and mesonotum usually dark; tegmina usually with a dark cloud...**ipomoeicola** Kirkaldy.

First antennal segment much shorter, either only about as long as broad or about two-fifths longer than broad, but never nearly twice as long as broad; face, pronotum and mesonotum usually pale, but if dark, then wings never with dark clouds.............................15

15(14). Face with round pale spots in derm; tegmina with a characteristic prominent dotting formed by unusually conspicuous dark granules on pale veins, dark color extending entirely across veins and slightly encroaching on membrane; first antennal segment about as broad as long.....................**koae-phyllodii** Muir.

Face without such pale spots; tegmina not so spotted, granules hardly if any darker than veins, but if distinctly darker, then dark color is confined to veins which are darker than membrane and are often brown: first antennal segment one- or two-fifths longer along top edge than breadth.............................16

16(15). Inner basal angles of genital styles, as seen from above, only slightly produced; pale forms (green when living) ....**koae** Kirkaldy.

Inner basal angles of genital styles distinctly produced into caudal knob-like protuberances (best seen obliquely from above); more reddish-brown species.......... ....**rubescens** (Kirkaldy).

17(7). Median frontal carina forking far down on front, near lower level of eyes or farther distad..................18

Median frontal carina forking near or on vertex..........20

18(17). Median frontal carina forking at or just above lower level of eyes; anal segment produced caudad; pygophore in rear view as illustrated in figure 82, f; aedeagus broadly expanded at apex.........**giffardi** Muir.
Median frontal carina forking far down on face, between lower edge of eyes and apex of frons..................19

19(18). Pygophore very short, nearly vertical behind and mostly concealed from above; both inner and outer apical angles of genital styles produced into sharp, conspicuous processes.......................**wailupensis** (Muir).
Pygophore not so formed; genital styles with outer apical angles bent cephalad instead of caudad as usual, so that when viewed from side they appear bent forward nearly at right angles beyond middle.........**rocki** Muir.

20(17). Vertex strongly produced and protuberant, as in figure 71, c; first antennal segment about as broad as long; small, pale, lowland species with milky white tegmina which are conspicuously spotted by coarse, dark granules on veins........................**leahi** (Kirkaldy).
Vertex not so produced; first antennal segment obviously longer than broad, usually conspicuously longer.......21

21(20). First antennal segment less than one-half as long as second (about one-third as long on holotype); (genital styles broad and flat, inner apical angles broadly triangular and more produced than rounded outer apical angles; aedeagus broad and thick at base, but rapidly narrowing to about middle, thence subequal in diameter, strongly arched; only male seen is the dissected holotype from which no characters of shape of pygophore can be described)..........................**incommoda** Muir.
First antennal segment more than one-half as long as second...22

22(21). Anal segment strongly produced caudad, its hind part turned outward and downward and more or less shaped like an extended tongue; pygophore, as seen from behind, pinched inward at hind edges of anal segment ....**gouldiae** Kirkaldy.
Anal segment not so formed.........................23

23(22). (Note: I have not examined an undissected specimen of any of the following six species. Additional characters, particularly of the pygophore, probably could be described if whole specimens were available for study.)
Pygophore, as seen in profile from side, with a large or rather large lobe-like expansion as in figure 69, a; (genital styles partly twisted or otherwise placed so that their narrowest edges largely are presented to view from directly behind and their apices are subcontiguous or rather close together)..........................24
Pygophore not so formed, or if with a rather similar lateral lobe-like expansion, then with apices of slender styles turned outward and assuming a sort of a lyre-shape (as in figure of *koebelei*), or otherwise different...25

24(23). Tegmina leaving pygophore and last two abdominal tergites exposed; length about 4.5 mm....... **gigantea** (Muir).
Tegmina reaching nearly to apex of abdomen; length less than 4 mm........................ **neowailupensis** (Muir).

25(23). Anal segment without spines; genital styles as seen in broadest view as in figure 79, l; aedeagus as in figure 79, k.............................. **timberlakei** Muir.
Anal segment with well-developed spines...............26

26(25). Aedeagus peculiarly shaped as in figure 77, j, greatly expanded dorsally and ventrally into a broad "head"; anal spines long, slender, recurved, shaped like a snake's fangs (as seen from side), as in figure 77, k; genital styles shaped as in figure 77, l........ **sharpi** Muir.
Not such species, although anal spines may be fang-like...27

27(26). Genital styles curved outward (strongly divergent) beyond middle (as seen from behind); styles, aedeagus and anal spines shaped as in figure 70, j–l... **koebelei** Muir.
Genital styles slightly convergent (as seen from behind): styles, aedeagus and anal spines as in figure 71, h–j .... **lobeliae** Muir.

KEY TO THE MOLOKAI NESOSYDNE

(Males. Five species.)

1. Median keels not strongly protuberant as they come into view over fore edge of vertex as seen from above, vertex rather evenly convex in front; lower hind margin of pygophore without a median protuberance...... 2
Median keels of vertex distinctly protuberant and discontinuous with remainder of profile of fore edge of vertex; caudal margin of pygophore produced into a conspicuous protuberance at middle..................... 4

2(1). A very large, bulky species about 4 mm. or more long; first antennal segment about three times as long as broad, about three-fourths as long as second segment and longer than breadth of narrowest interocular breadth of frons.................. **procellaris** Kirkaldy.
Much smaller species; first antennal segment either about as long as broad or about twice as long as broad, shorter than narrowest interocular breadth............ 3

3(2). A tiny species about 1.5–2.0 mm. in length; first antennal segment only slightly longer than broad; genital styles broad, flat, expanded at apices on both inner and outer corners, so arranged that gap between them formed by their inner edges is O-shaped; tegmina not reaching end of abdomen...................... **fullawayi** (Muir).
Usually over 2 mm. long; first antennal segment nearly twice as long as broad; genital styles long and slender, space between them U-shaped; tegmina surpassing apex of pygophore................ **ipomoeicola** Kirkaldy.

4(1). Pygophore shaped as in figure 76, l, with a small spine-line protuberance about half way up side, sides not excavate (as seen from side) .... **palustris** Kirkaldy.
Pygophore shaped as in figure 61, b, sides excavate at about middle (as seen from side) and without a sub-median spine on lateral margin, but with a spine on lateral margin at about lower third..... **nubigena** Kirkaldy.

KEY TO THE LANAI NESOSYDNE

(Males. Seven species.)

1. First antennal segment at most only slightly longer than broad 2
First antennal segment much longer than broad......... 3

2(1). Usually brachypterous; only about 1.5–2.0 mm. long; genital styles comparatively broad and flat; on *Styphelia* .... **lanaiensis** (Muir).
Normally macropterous; over 2.0 mm. in body length (4.5 mm. including tegmina); genital styles comparatively long and slender; on *Acacia*.................. .... **rubescens** (Kirkaldy).

3(1). Fore contour of vertex as viewed from above conspicuously interrupted by the strongly protuberant median carinae; median frontal carina forking near (but obviously above) lower level of eyes... .**nesogunnerae** Muir.
Fore contour of vertex as seen from above subcontinuously convex and carinae not obviously protuberant..... 4

4(3). Pygophore as viewed from side with two large, concave excavations in caudal margin as in figure 61, e, f; dorsal anal angles of pygophore as seen from above, projecting, incurved and appearing to grasp anal segment; genital styles shaped as in figure 72, k, l........... ....**nephelias** Kirkaldy.
Not such species.................................... 5

5(4). Genital styles long, slender, erect, comparatively narrowly exposed in rear view, obviously distinct from shape and proportions of following two species, space between them broadly open and broadly U-shaped.... .... **ipomoeicola** Kirkaldy.
Not so; styles broadly exposed in rear view, inner apical angles, if brought together, with space between them sub-O-shaped 6

6(5). Face, genae, pronotum and scutellum mostly black; aedeagus not shaped like an arrowhead............ .... **nigriceps** Muir.
Face, genae, pronotum and scutellum marked with black but mostly pale; aedeagus strongly barbed apically and thus appearing arrowhead-like or harpoon-like in outline .... **hamata** Muir.

KEY TO THE MAUI NESOSYDNE

(Males. Thirty-four species; *N. haleakala* omitted.)

1. First antennal segment rarely twice as long as broad, if about twice as long as broad, then never longer than narrowest interocular breadth of frons (measure length along top edge and breadth at apex) 2
   First antennal segment usually distinctly more than twice as long as broad, always fully as long as or distinctly longer than narrowest interocular breadth 26

2(1). Caudal margin of pygophore with a prominent, tooth-like or blunt, spine-like, median protuberance on lower margin .... **amaumau** (Muir).
   Pygophore without a median protuberance on lower hind margin 3

3(2). Median frontal carina forking far down on face, at or below lower level of eyes, thus double for most of its length 4
   Median carina forking much higher on face, nearer fore angle of vertex 7

4(3). Vertex, when viewed from directly above, unusually short and broad, median line shorter than breadth of base; a tiny species, tegmina less than 1.0 mm. long on male holotype; first antennal segment about 0.7 as long as broad .... **ahinahina** (Muir).
   Vertex conspicuously longer than broad and/or tegmina over 1.5 mm. long 5

5(4). Median frontal carina forking at about lower level of eyes; vertex little longer along median line than breadth of base .... **perkinsi** Muir.
   Median frontal carina forking below lower level of eyes, nearer apex; vertex conspicuously longer than broad.... 6

6(5). Protuberance formed on vertex by median frontal carinae narrow and comparatively sharply and narrowly protuberant; genae and areas between carinae on frons and clypeus yellowish-brown, not black; first antennal segment about one-third longer than broad... **kokolau** (Muir).
   Protuberance formed on vertex by median carinae of face broad and low; genae and intercarinal areas on clypeus and frons black; first antennal segment about twice as long as broad .... **painiu** (Muir).

7(3). First antennal segment less than twice as long as broad, usually distinctly shorter (measure carefully, for optical illusions may confuse you) 8
   First antennal segment approximately twice as long as broad 21

8(7). Tegmina usually subopaque and whitish, but always conspicuously spotted by comparatively large, coarse, dark granules on veins 9
   Tegmina not conspicuously spotted, even if whitish or subopaque, granules not prominent 11

9(8). Outer apical angles of genital styles not strongly produced as in *osborni* (fig. 76, e) and *bridwelli* (fig. 66, a), but inner apical angle appearing more produced; lateral outlines of caudal margin of pygophore as seen directly from rear arcuate but not very lobate (as in fig. 81, d) thus appearing comparatively narrow and higher than broad........................**tetramolopii** (Muir).

Outer apical angles of genital styles strongly produced as in figures 66, a, and 76, e; lateral outlines of caudal margin of pygophore as seen from directly behind rather strongly, broadly lobate (as in fig. 81, c)........10

10(9). Aedeagus expanded at apex as in figure 76, g..**osborni** Muir.

Aedeagus slender, acuminate, as in figure 66, b..**bridwelli** (Muir).

11(8). Distance between fore edge of an eye and lateral facial carina only about one-half as great as distance from lateral facial carina to apex of angle between frons and vertex (as seen in profile from side); an entirely pale species; as seen from directly above, top of pygophore broadly concave behind as in figure 73, c, not notched in a sub-V-shape, anal segment conspicuously exposed from above.............................**mauiensis** (Muir).

Distance from fore edge of an eye to lateral facial carina greater than, as great as, or nearly as great as distance from lateral facial carina to apex of frons as seen from side; either pale or dark species, but if pale, pygophore not shaped as above..............................12

12(11). Tegmina very short, not reaching pygophore............13
Tegmina reaching or surpassing pygophore.............15

13(12). Pronotum short, median keel only about as long as distance between its apex and apex of a lateral keel, or shorter............................**nigrinervis** (Muir).

Median keel of pronotum fully two-thirds or three-fourths as long as distance between hind ends of lateral pronotal keels 14

14(13). Very dark species, most of body black; pygophore exposed from above and with styles fully and broadly exposed from side (as in fig. 65, g)..**argyroxiphii** Kirkaldy.

Paler, brownish species with nota of thorax, top of head and legs pale; pygophore almost entirely withdrawn beneath last complete abdominal tergite and almost entirely concealed from above and from side..**eeke** (Muir).

15(12). Face pale between carinae; tegmina without dark maculae; macropterous forms...........................16

Face black between carinae; tegmina with dark maculae; brachypterous forms 17

16(15). Genital styles short and broad........**pseudorubescens** Muir.
Genital styles long and slender........**rubescens** (Kirkaldy).

17(15). An almost entirely black species, keels of face and thoracic nota all black; pygophore shaped as in figure 72, i; genital styles short, not or barely extending up beyond dorsal edge of diaphragm, their ectal angles more strongly produced than inner apical angles and near where their tips reach sides of pygophore there is a rather obscure (usually) inwardly projecting boss-like protuberance of inner wall of edge of pygophore .... **monticola** Kirkaldy.

Not such species 18

18(17). Genital styles each with a prominent boss or protuberance on posterior face at about middle of inner edge, appearing conspicuously protuberant when viewed from directly above 19

Without such protuberances on genital styles 20

19(18). Protuberance on inner edge of genital styles round and boss-like as in figure 78, i–k; aedeagus angulate at apex .... **pilo** (Muir).

Protuberance on inner edge of genital styles elongate, not round, as in figure 69, l, m; aedeagus roundly subtruncate at apex .... **imbricola** Kirkaldy.

20(18). Outer apical angles of genital styles more strongly produced than inner angles, space between inner edges of styles more nearly inverted keyhole-shaped than O-shaped; underside of anal segment conspicuously concave .... **raillardiicola** (Muir).

Inner apical angles of styles more strongly produced than outer angles, space between inner edges O-shaped; underside of anal segment not concave..... **geranii** (Muir).

21(7). Genital styles long and slender, reaching anal segment, space between them wide-open and U-shaped........ .... **ipomoeicola** Kirkaldy.

Genital styles not so formed, broad and flat as seen from behind 22

22(21). Genital styles short, not extending above top edge of diaphragm, distant from lower edge of anal segment, which is grooved or arch-like beneath............... 23

Genital styles longer, extending above diaphragm to near lower edge of anal segment which is not grooved or arch-like beneath except in *dubautiae*................. 24

25(22). Anal segment broadly concave and arch-like beneath, anal spines far distant from aedeagus; genital styles, as seen from directly above, each with a prominent protuberance projecting caudad at about middle of inner side............................... **imbricola** Kirkaldy.

Anal segment comparatively narrowly grooved beneath, anal spines close to aedeagus; genital styles plain, without any protuberance from inner edges............ .... **stenogynicola** (Muir).

24(22). Genital styles peculiarly formed as in figure 74, f, outer apical angle broadly and strongly produced, inner edge strongly irregular in posterior outline as seen from

side, with a conspicuous protuberance below inner apical angle.................... **nephrolepidis** Kirkaldy.
Genital styles not so formed.......................... 25

25(24). Inner basal angles of styles not strongly produced, space between inner margins of styles thus collectively elongate-lenticular in outline from base to apex; underside of anal segment not obviously arch-like.......... .... **mamake** (Muir).
Inner basal angles of styles strongly protuberant, space between their inner margins roughly inverted subcordate in shape from just below middle to apex; underside of anal segment arch-like with anal spines widely separated and divergent............... **dubautiae** (Muir).

26(1). Dorsal apical (anal) angles of pygophore produced so that a line drawn between their apices encloses anal segment 27
Anal angles of pygophore not produced, a line drawn between their apices passes in front of caudal margin of anal segment 29

27(26). Anal angles of pygophore not so strongly produced nor curved inward as described below; diaphragm normally concealed by styles, much narrower at sides of armature than distance between lower end of armature and lowest part of caudal margin of pygophore; armature broad and heavy......................... **umbratica** Kirkaldy.
Anal angles of pygophore unusually strongly prolonged, curved strongly inward and downward toward aedeagus when viewed from behind, projecting far beyond anal segment when viewed from directly above and curved inward toward each other so that their apices are closer together than breadth of anal segment; diaphragm unusually wide, longer at side of armature than distance from lower end of armature to lowest part of caudal margin of pygophore, broadly exposed; armature long and narrow 28

28(27). Pygophore, when viewed directly from side, with projecting anal angles distinctly visible as in figure 81, a, and appearing somewhat as hook-like protuberances; inner margin of genital style with an irregularity or projection slightly basad of middle............... .... **waikamoiensis** (Muir).
Pygophore, when viewed directly from side, with projecting anal angles not visible, as in figure 72, a; inner margin of genital style with a tooth-like protuberance just distad of middle.................. **longipes** (Muir).

29(26). Genital styles broad and flat, expanded to very broad apices, without protuberances on inner margin above middle.. 30
Genital styles comparatively long and slender and/or narrowing distad and/or with a protuberance on inner margin above middle............................ 31

30(29). When viewed from directly above, inner hind margins of genital styles are seen to be on an even plane from base

to apex and not made irregular by protuberances or irregularities of contour . . . . **acuta** (Muir).
Genital styles, as seen from directly above, with inner margins obviously discontinuous, projecting somewhat caudad at about middle and with basal angles protuberant . . . . **nesopele** (Muir).

31(29). . (Note: I have examined only the holotypes of the following three species. The pygophores had been removed and the parts mounted in balsam on slides.)
Anal spines very large, curved caudad or outward; aedeagus unusually broad, apex blunt, with transverse rows of teeth and a deep dorsal groove (fig. 79, d); genital styles as in figure 79, e . . . . **sulcata** (Muir).
Anal spines curved cephalad; aedeagus slender, acuminate, teeth arranged in longitudinal rows; genital styles each with a well-developed, tooth-like, subapical protuberance as in figures 67, c, and 73, e 32

32(31). Genital styles, anal spines and aedeagus as in figure 67, c–e . . . . **cyrtandrae** Muir.
Genital styles, anal spines and aedeagus as in figure 73, e, g, h . . . . **neocyrtandrae** (Muir).

KEY TO THE HAWAII NESOSYDNE

(Males. Seventeen forms.)

1. First antennal segment distinctly less than twice as long as broad 2
First antennal segment about twice as long as broad or distinctly longer 11

2(1). Tegmina conspicuously dotted by prominent setigerous granules; median carinae of frons and vertex prominently raised; genital styles broad and flat, outer apical angles sub-hook-shaped; anal segment broadly arch-like beneath, anal spines broadly separated . . . . **chambersi** Kirkaldy.
Without such a combination of characters 3

3(2). Tiny species from *Styphelia*, usually distinctly less than 2 mm. long; tegmina less than 1 mm. long, subopaque, milky-white; vertex and most of frons yellow, most of genae, clypeus and a broad band across apex of frons dark; length of median pronotal carina shorter than distance between its caudal end and apex of a lateral carina . . . . **cyathodis** Kirkaldy.
Not such species 4

4(3). Anal segment (as viewed from directly above) with hind margin deeply, broadly, conspicuously emarginate as in figure 66, i . . . . **coprosmicola** (Muir).
Anal segment without such a deep, broad emargination, at most only slightly emarginate (compare *neoraillardiae*). 5

5(4). Genital styles (as seen from directly behind) broad and flatly exposed or short and broad 6

Genital styles (as seen from directly behind) elongate, comparatively long and slender and/or comparatively narrow as seen from behind........................ 8

6(5). Genital styles short, not strongly expanded at outer apical angles; anal segment not broadly arch-like beneath..................................... **pseudorubescens** Muir.

Genital styles broadly expanded outward at outer apices as in figures 74, a, and 77, f; anal segment broadly concave beneath 7

7(6). Genital styles each expanded at outer apical angles to form long expansions as in figure 77, f (on *Raillardia*) ....**raillardiae** Kirkaldy.

Genital styles with outer apical angles less strongly produced as in figure 74, a (on *Lipochaeta*).. **neoraillardiae** (Muir).

8(5). Diaphragm of pygophore appearing more nearly horizontal than vertical; armature thin, lamella-like, long from back to front, its dorsal edge armed with a pair of divergent spines..................**phyllostegiae** Muir.

Diaphragm placed more nearly vertical; armature thick, stout 9

9(8). When viewed from directly above, inner basal angles of genital styles only slightly protuberant caudad; pale forms (green when living)...............**koae** Kirkaldy.

When viewed from above, inner basal angles of styles comparatively strongly protuberant; comparatively dark forms 10

10(9). Mesonotum yellowish-brown.........**rubescens** (Kirkaldy).

Mesonotum dark brown or mostly black.. **rubescens pele** (Kirkaldy).

11(1). Anal angles of pygophore(as seen from directly above) produced into distinct protuberances which project distinctly caudad of hind margin of anal segment.........12

Anal angles of pygophore not produced and not protuberant 13

12(11). Pygophore, as seen directly from side, with hind edge only slightly concave below protuberant anal angle and without an angle on margin at about middle, not as in figure 64, a.......................**umbratica** Kirkaldy.

Pygophore with caudal margin deeply excavated below protuberant anal angle and with an angle at about middle, as in figure 64, a...................**aku** (Muir).

13(11). First antennal segment fully three times as long as broad, one-third longer than narrowest interocular breadth... **ulehihi** (Muir).

First antennal segment only about twice as long as broad and at most barely longer than narrowest interocular breadth 14

14(15). Genital styles long and rather slender, comparatively narrowly exposed from rear view, apices widely separated, space between them widely open and U-shaped.. **ipomoeicola** Kirkaldy.

Styles broadly and flatly exposed to rear view............15

15(14). Outer apical angle of each genital style strongly produced to form a long, acute triangle, its dorsal margin nearly straight as in figure 67, g; inner margins without any protuberances above base............**cyrtandricola** Muir.
Genital styles not so formed, inner margins expanded or protuberant above middle.............................16

16(15). Median length of vertex only slightly longer than breadth at base; genital styles extending up to level of anal segment, shaped as in figure 74, f...**nephrolepidis** Kirkaldy.
Median length of vertex about twice as long as breadth across base; genital styles rather short, not extending much above dorsal level of diaphragm.......**anceps** Muir.

All the species in the following list are brachypterous in both sexes as far as is known, unless otherwise mentioned.

The types of Muir's species are in the collection of the Hawaiian Sugar Planters' Association Experiment Station in Honolulu, and those of Kirkaldy's are in the British Museum with the exception of those mentioned below as being now in the Bishop Museum.

Nesosydne acuta (Muir), new combination (fig. 64, g–j).
Ilburnia acuta Muir, 1919:96, pl. 4, figs. 9, 11.

Endemic Maui (type locality: "Ridge South of Iao Valley").
Hostplant: *Cyrtandra mauiensis.*

Nesosydne ahinahina (Muir), new combination (fig. 64, f).
Ilburnia pulla Muir, 1919:98, pl. 3, fig. 6; pl. 4, fig. 17. Not Muir, 1916:186.
Ilburnia ahinahina Muir, 1922:102.

Endemic. Maui (type locality: Mount Eke (Eeke), 5,000 feet).
Hostplant: *Argyroxiphium* ("ahinahina"; the native word means silvery gray and refers to the color of *Argyroxiphium,* the silversword plant).

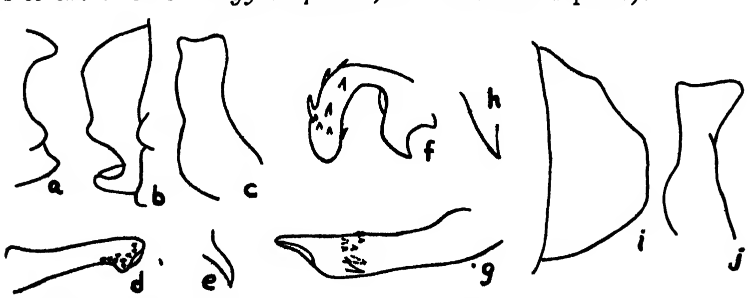

Figure 64—Details of *Nesosydne* genitalia **a–e,** *N. aku* (Muir): (**a**) outline of caudal margin of pygophore of holotype from left side, at a more dorsally oblique angle than **b**; (**b**) same as **a**, but directly from right side of paratype; (**c**) right style in balsam; (**d**) aedeagus in balsam; (**e**) anal spine in balsam. **f,** *N. ahinahina* (Muir), aedeagus in balsam. **g–j,** *N. acuta* (Muir): (**g**) aedeagus in balsam; (**h**) anal spine in balsam; (**i**) outline of caudal margin of pygophore as seen from right side; (**j**) right style in balsam.

Nesosydne aku (Muir), new combination (fig. 64, a–e).
Ilburnia aku Muir, 1921:513, pl. 8, figs. 14, 14a.

Endemic. Hawaii (type locality: Olaa, 23 miles, 2,300 feet).
Hostplant: *Cyanea tritomantha* ("aku").

Nesosydne amaumau (Muir), new combination and emendation (fig. 65, a–d).
Ilburnia amamau Muir, 1921:512, pl. 8, figs. 19, 19a.

Endemic. Maui (type locality: Mount Haleakala, 6,100 feet).
Hostplant: *Sadleria* fern ("amaumau").

"The nymphs are uniformly light brown. There is the usual tendency for some specimens to be lighter than others and for the females to be lighter than the males. This species comes next to *I. painiu* Muir, to which it is closely related." (Muir, 1921:513.)

Because of a misspelling in Hillebrand's *Flora of the Hawaiian Islands,* Muir called this species *"amamau"* instead of *"amaumau."* He obviously named the insect after its hostplant, and we should correct the spelling.

Nesosydne anceps Muir (fig. 65, e, f).
Nesosydne anceps Muir, 1916 187, pl. 2, fig. 34.
Ilburnia anceps (Muir), of authors.

Endemic. Hawaii (type locality: Glenwood).
Hostplant: *Freycinetia* (Giffard, 1918:411, notes).

Nesosydne argyroxiphii Kirkaldy (fig. 65, g).
Nesosydne argyroxiphii Kirkaldy, 1908:203, fig. 1; pl. 4, fig. 6. 1910:590.
Ilburnia argyroxiphii (Kirkaldy) Muir, 1919:89, female.

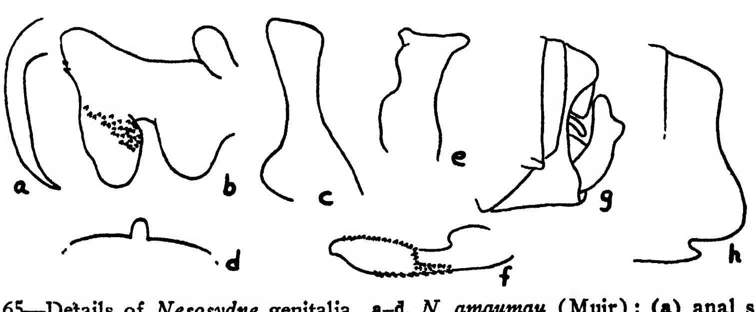

Figure 65—Details of *Nesosydne* genitalia. a–d, *N. amaumau* (Muir): (a) anal spine; (b) aedeagus; (c) right style (a–c, in balsam); (d) ventral part of hind margin of pygophore as seen from directly above to show median protuberance. e, f, *N. anceps* Muir: (e) right style in balsam; (f) aedeagus in balsam (anal spines long and slender, but not drawn because of their poor position on the slide). g, *N. argyroxiphii* Kirkaldy, outline of pygophore as seen from left side. h, *N. asteliae* Muir, cotype, outline of caudal margin of pygophore from left side.

Endemic. Maui (type locality: Haleakala Crater, about 10,000 feet).

Hostplant: *Argyroxiphium sandwicense.*

Kirkaldy (1910:590) described the last instar nymphs as follows: "brownish testaceous, largely suffused with dark fuscous." The insect feeds upon young silversword plants.

The eggs are evidently parasitized by a *Polynema* mymarid wasp.

The holotype is in the British Museum. Perkins says in his letter that "I found this species in great abundance, together with the larvae of a remarkable (undescribed) Phycitid moth, but I suppose the leaf-hoppers were lost." The moth referred to was later described by Hampson as *Rhynchephestia rhabdotis.*

Nesosydne asteliae Muir (figs. 63, f; 65, h).
Nesosydne asteliae Muir, 1917:307, pl. 5, fig. 13.
Ilburnia asteliae (Muir), of authors.

Endemic. Oahu (type locality: Mount Kaala, 4,000 feet).

Hostplant: *Astelia veratroides.*

This appears to be an ally of *halia.*

Nesosydne boehmeria (Muir), new combination (fig. 66, c).
Ilburnia boehmeria Muir, 1921:514, pl. 8, figs. 12, 12a.

Endemic. Oahu (type locality: Makaleha Valley).

Hostplant: *Boehmeria.*

This form is much like *pipturi.*

Nesosydne bridwelli (Muir), new combination (figs. 66, a, b; 81, c).
Ilburnia bridwelli Muir, 1919:90, pl. 3, fig. 3; pl. 4, fig. 20.

Endemic. Maui (type locality: Mount Haleakala, about 7,000 feet, near Puu Nianiau).

Hostplants: *Argyroxiphium virescens, Argyroxiphium sandwicense, Dubautia.*

"The nymph is dark brown, lighter on carinae, at base of abdomen and mottled over tegminal pads." (Muir, 1919:91.)

This form is so much like *osborni* that I feel further study is required to clarify its position.

Nesosydne campylothecae (Muir), new combination (fig. 66, d–f).
Ilburnia campylothecae Muir, 1922:97, pl. 3, fig. 11.

Endemic. Kauai (type locality: Kumuwela).

Hostplant: *Campylotheca.*

Nesosydne chambersi Kirkaldy (fig. 66, g, h).

Nesosydne chambersi Kirkaldy, 1908:202, pl. 4, figs. 10–12; 1910:590. Muir, 1916:142, pl. 3, fig. 44.

Ilburnia chambersi (Kirkaldy), of authors.

Endemic. Hawaii (type locality: Kilauea, 4,000 feet).

Hostplant: *Raillardia ciliolata.*

The type mount consisting of two pairs is now in the Bishop Museum. Perkins remarks in his letter that "I could not find specimens of this with name attached, but one card of mine had a red label and are clearly this species. They are not the earliest I took, however. It is curious that K. should have omitted reference to my specimens of this species because he must have known it was in connection with these small species on *Raillardia* that I made special observations on *Pipunculus.* He apparently did not describe at all the extremely abundant species on *Pipturus,* on which I particularly noticed *Stylops, Gonatopus,* and *Pipunculus* and also the ineffective attacks of *Nesomimesa* at Kilauea."

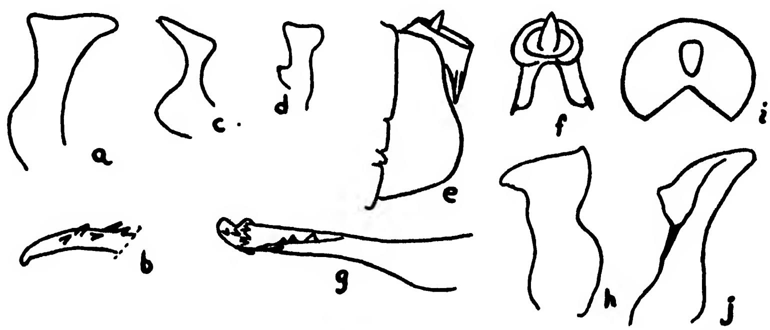

Figure 66—*Nesosydne* genitalia details. **a, b,** *N. bridwelli* (Muir): **(a)** right style; **(b)** apical part of aedeagus as seen protruding from holotype, dry. **c,** *N. boehmeria* (Muir): right style (dry) of holotype. **d–f,** *N. campylothecae* (Muir): **(d)** right style, in balsam; **(e)** pygophore as seen from left side; **(f)** anal segment from behind. **g, h,** *N. chambersi* Kirkaldy: **(g)** aedeagus, in balsam; **(h)** left style. **i, j,** *N. coprosmicola* (Muir): **(i)** anal segment as seen from above; **(j)** right style of paratype.

Nesosydne coprosmicola (Muir), new combination (fig. 66, i, j).

Ilburnia coprosmicola Muir, 1919:103, pl. 4, fig. 18.

Endemic. Hawaii (type locality: Olaa, 27 miles).

Hostplant: *Coprosma ernodioides.*

The nymphs are dark brown with paler markings.

Nesosydne cyathodis Kirkaldy (fig. 67, a, b).

Nesosydne cyathodis Kirkaldy, 1910:589. Muir, 1916:192, pl. 3, fig. 48.

Ilburnia cyathodis (Kirkaldy), of authors.

Endemic. Hawaii (type locality: Kilauea, 4,000 feet).

Hostplant: *Styphelia* (*Cyathodes*) *tameiameiae.*

Kirkaldy (1910:589) described the last instar nymphs.

There is a group of closely allied forms centering around this species. Muir (1919:91) decided that they were equivalent to subspecies and varieties and he listed varieties *fullawayi, lanaiensis*, and *nigrinervis* and subspecies *eeke* hereunder. He said that these forms "are of great interest as among them we have considerable chroötic but practically no phallic differences." However, I believe that there are quite distinct phallic differences. The two forms with most closely similar aedeagi and genital styles are *fullawayi* and *lanaiensis,* but, as my sketches illustrate, the other forms have greater differences. The differences evident in the drawings together with external differences which are striking in some of the species lead me to consider that these forms are entitled to specific rank.

Perkins, in a letter, states that he took this species and *raillardiae* in 1903 when he was collecting a *Pipunculus* which flew around the plants infested by the species, but Kirkaldy did not credit him with taking either of the species.

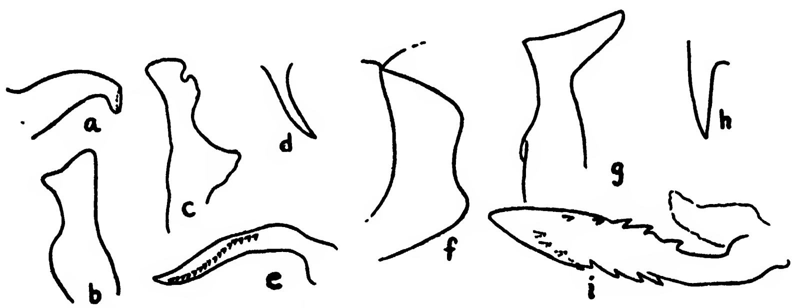

Figure 67—*Nesosydne* genitalia. **a, b,** *N. cyathodis* Kirkaldy: **(a)** aedeagus, in balsam; **(b)** right style, in balsam. **c–e,** *N. cyrtandrae* Muir, holotype, parts in balsam: **(c)** right style; **(d)** anal spine; **(e)** aedeagus. **f–i,** *N. cyrtandricola* Muir: **(f)** outline of pygophore as seen from left side; **(g)** right style of cotype; **(h)** anal spine in balsam; **(i)** aedeagus in balsam.

Nesosydne cyrtandrae Muir (figs. 67, c–e; 82, e).

Nesosydne cyrtandrae Muir, 1916:189, pl. 3, fig. 38; pl. 4, figs. 67, 69.

Ilburnia cyrtandrae (Muir), of authors.

Endemic. Maui (type locality: Nahiku).

Hostplant: *Cyrtandra.*

The male holotype is a dissected, teneral individual with the right side of the interocular part of the frons collapsed to such an extent that I cannot be certain of the degree of protuberance of the median carina on the fronto-vertex angle. The original description is inadequate.

Nesosydne cyrtandricola Muir (fig. 67, f–i).

Nesosydne cyrtandricola Muir, 1918:407, figs. 1, 2.

Ilburnia cyrtandricola (Muir), of authors.

Endemic. Hawaii (type locality: Glenwood, Olaa, 2,300 feet).
Hostplants: *Cyrtandra, Charpentiera obovata.*

"The young nymphs are light green, later acquiring dark marks similar to the adults. The species comes near to *N. anceps* but is quite distinct." (Muir, 1918:407.)

Nesosydne dubautiae (Muir), new combination (fig. 68, a, b).
Ilburnia dubautiae Muir, 1921:510, pl. 8, fig. 10.

Endemic. Maui (type locality: ridge south of Iao Valley, 2,000 feet).
Hostplant: *Dubautia plantaginea.*

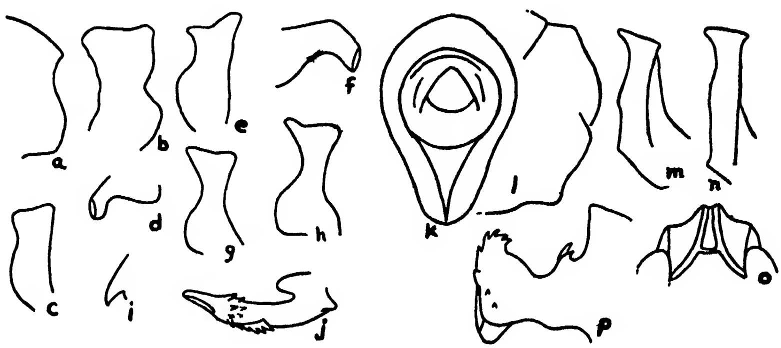

Figure 68—Genitalia of *Nesosydne*. **a, b,** *N. dubautiae* (Muir): **(a)** hind margin of pygophore as seen from left; **(b)** left style. **c, d,** *N. eeke* (Muir): **(c)** right style in balsam; **(d)** aedeagus in balsam. **e, f,** *N. fullawayi* (Muir), holotype: **(e)** right style; **(f)** aedeagus, dry dissection. **g–j,** *N. gerani* (Muir): **(g)** right style, paratype, in balsam; **(h)** right style of another example from a slightly different angle, in balsam; **(i)** anal spine in balsam; **(j)** aedeagus, in balsam. **k–o,** *N. gouldiae* Kirkaldy: **(k)** anal segment; **(l)** hind edge of pygophore as seen from left side; **(m)** right style, oblique caudad view; **(n)** right style directly from rear; **(o)** vertex as seen from above. **p,** *N. giffardi* Muir, aedeagus, dry dissection.

Nesosydne eeke (Muir), new combination (fig. 68, c, d).
Ilburnia cyathodis subspecies *eeke* Muir, 1919:92.

Endemic. Maui (type locality: Mount Eke (Eeke), 5,000 feet).
Hostplant: *Argyroxiphium.*

I have raised this form to full specific rank, for I believe that its characters indicate that it is not just a subspecies of *cyathodis*. Its facies is really quite distinct from that of *cyathodis.*

Nesosydne fullawayi (Muir), new combination (fig. 68, e, f).
Ilburnia fullawayi Muir, 1916:192.
Ilburnia cyathodis variety *fullawayi* (Muir) Muir, 1919:91.

Endemic. Molokai (type locality: Kamoku).

Hostplant: *Styphelia* (*Cyathodes*).

Muir (1916:193) recorded this species from Maui, but I doubt that it occurs on that island. I consider this form specifically distinct from *N. cyathodis* (see the discussion under that species).

Nesosydne geranii (Muir), new combination (fig. 68, g–j).
Ilburnia geranii Muir, 1921:515, pl. 8, figs. 13, 13a.

Endemic. Maui (type locality: Mount Haleakala, 6,000 feet).

Hostplant: *Geranium arboreum*.

According to Muir, the nymphs are pale brown with dark brown at the bases of the tegminal pads and on the sides of the abdominal tergites.

This species was originally called *geraniorum* by Muir and his type series was so labeled; then the labels were written over to *geranii* (the published name), but the correction is not always very distinct on the specimen labels.

Nesosydne giffardi Muir (figs. 68, p; 82, f).
Nesosydne giffardi Muir, 1916:194, pl. 3, fig. 54; pl. 4, fig. 74.
Ilburnia giffardi (Muir), of authors.

Endemic. Oahu (type locality: Mount Tantalus).

Hostplants: *Cyrtandra grandiflora, Rollandia crispa.*

Nesosydne gigantea (Muir), new combination (fig. 69, a, b).
Ilburnia gigantea Muir, 1921:517, pl. 8, fig. 15.

Endemic. Oahu (type locality: Castle Trail, about 2,000 feet).

Hostplant: *Pritchardia* palm.

This species shares with *I. procellaris* the distinction of being the largest in the genus (4.5 mm.). It is closely similar to *I. neowailupensis* in structure of the pygophore and its appendages.

Nesosydne gouldiae Kirkaldy (fig. 68, k–o).
Nesosydne gouldiae Kirkaldy, 1910:586. Muir, 1916:189, pl. 3, fig. 39.
Ilburnia gouldiae (Kirkaldy), of authors.

Endemic. Oahu (type locality: Mount Tantalus).

Hostplants: *Cyrtandra grandiflora, Cyrtandra* sp. (The species was originally recorded from *Gouldia,* and so specifically named, but the host record was erroneous.)

The nymphs have been described by Kirkaldy (1910:586). The type is supposedly in the British Museum.

Nesosydne gunnerae Muir (figs. 63, i; 69, h–j).
Nesosydne gunnerae Muir, 1917:305, pl. 5, fig. 15.
Ilburnia gunnerae (Muir), of authors.

Endemic. Oahu (type locality: Mount Kaala, about 4,000 feet).

Hostplants: *Gunnera petaloidea* (adults and nymphs mostly along the undersides of the midribs of old leaves); accidental (?) captures on *Pelea, Coprosma longifolia* and *Myrsine* (*Suttonia*).

Nesosydne haleakala Kirkaldy (fig. 62, e).
Nesosydne haleakala Kirkaldy, 1910:587. Muir, 1916:197.
Ilburnia haleakala (Kirkaldy), of authors.

Endemic. Maui (type locality: Mount Haleakala, 5,000 feet).

I have seen only two damaged specimens, both (?) females, which are in the Bishop Museum and which are apparently the specimens originally examined by Kirkaldy. It will take considerable comparative study to place this species properly,

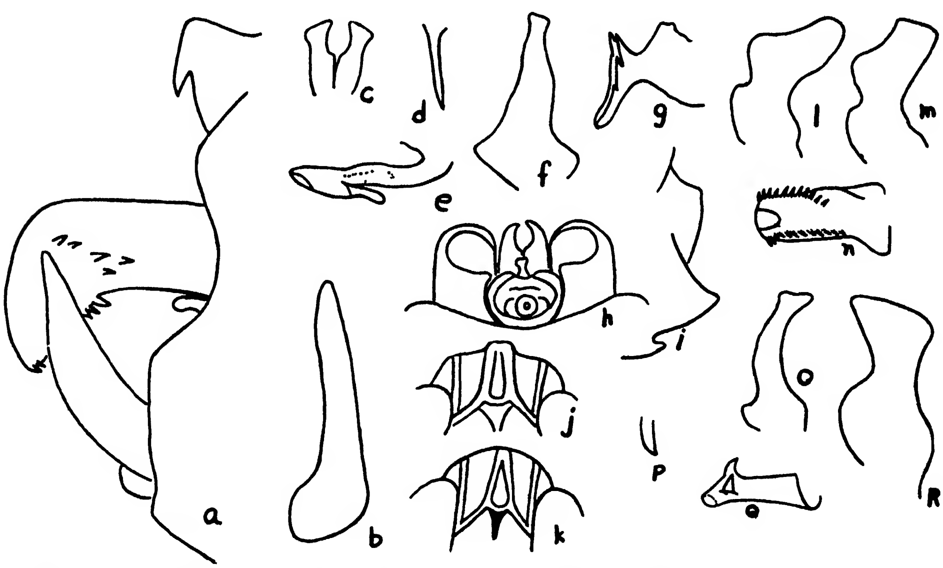

Figure 69—*Nesosydne* genitalia. **a, b**, *N. gigantea* (Muir): **(a)** pygophore as seen from right side (aedeagus may have more teeth, but this sketch was made from a dry specimen); **(b)** right style from directly behind. **c–e**, *N. hamata* Muir: **(c)** styles from behind, in balsam; **(d)** anal spine, holotype, in balsam; **(e)** aedeagus, holotype, in balsam. **f, g**, *N. halia* Kirkaldy: **(f)** left style in balsam; **(g)** aedeagus in balsam. **h–j**, *N. gunnerae* Muir: **(h)** pygophore viewed from above; **(i)** caudal margin of pygophore seen from left side; **(j)** front part of vertex as seen from above to show protuberant median keels. **k–n**, *N. imbricola* Kirkaldy: **(k)** front part of vertex seen from above to show non-protuberant median keels; **(l)** broad view of style; **(m)** style from slightly different angle (**l**, and **m**, in fluid); **(n)** aedeagus, in balsam (from paratype of "*coprosmae*"). **o–q**, *N. ipomoeicola* Kirkaldy: **(o)** right style in balsam; **(p)** anal spine in balsam; **(q)** aedeagus in balsam. **r**, *N. incommoda* Muir, holotype, right style.

because no males have as yet been associated with it. When additional material is assembled, it should be compared with ***amaumau*** (Muir). The holotype, also a female, is in the British Museum, and it is figured here. The one example at the Bishop Museum, which has its anal segment intact, does not have it concave behind as the artist has indicated on the holotype. This is a large species similar to ***amaumau*** (judging from the female), if it is not the same.

Nesosydne halia Kirkaldy (figs. 69, f, g; 82, a).

Nesosydne halia Kirkaldy, 1908:202, pl. 4, fig. 8; 1910:584. Muir, 1916:194, pl. 3, fig. 52.
Ilburnia halia (Kirkaldy), of authors.
Nesosydne halia "var." Kirkaldy, 1910:585.
Ilburnia halia variety *fuscovittata* Metcalf, 1943:308. New synonym.

Endemic. Oahu (type locality: Mount Tantalus, 1,300 feet).
Hostplants: *Dubautia plantaginea, Freycinetia.*
Parasite: *Polynema ciliata* Perkins (Hymenoptera: Mymaridae), in the eggs.
The type should be in the British Museum.

There is no reason to maintain Metcalf's name, which he erected without knowing what Kirkaldy labeled as a variety. The coloration on the tegmina varies individually. This species is rather similar to *asteliae.*

Nesosydne hamadryas Kirkaldy.

Nesosydne hamadryas Kirkaldy, 1910:587.
Ilburnia hamadryas (Kirkaldy), of authors.

Endemic. Oahu (type locality: Mount Tantalus).

Only the long-winged female holotype is known. Muir did not know the species. The holotype is now in the Bishop Museum, and I have been unable to associate it with any other species, but I have not compared it with all of the known long-winged females. The first antennal segment is slightly more than twice as long as broad, about three-fourths the length of the second and as long as the narrowest interocular breadth of the frons. The outline of the front part of the vertex as viewed from above is convex without a protuberant median line. It looks superficially like *N. rubescens pele,* or one of the other associates of *koae,* but the elongate first antennal segment is distinctive.

Nesosydne hamata Muir (fig. 69, c–e).

Nesosydne hamata Muir, 1917:309, pl. 5, figs. 17, 17a.
Ilburnia hamata (Muir), of authors.

Endemic. Lanai (type locality: 3,000 feet).

Nesosydne imbricola Kirkaldy (figs. 62, b–d; 69, k–n).

Nesosydne imbricola Kirkaldy, 1910:590.

Ilburnia imbricola (Kirkaldy), of authors.

Ilburnia coprosmae Muir, 1919:93, pl. 3, fig. 2; pl. 4, fig. 21 (type from Olinda). New synonym.

Endemic. Maui (type locality: Mount Haleakala, 5,000 feet).

Hostplant: *Coprosma montana.*

The male holotype is in the British Museum, and a drawing of it is presented here. An examination of Muir's type material of his *coprosmae,* plus some fresh specimens collected by me in 1945, with the aid of the drawing of Kirkaldy's holotype of *imbricola* have enabled me to establish the above synonymy.

Nesosydne incommoda Muir (fig. 69, r).

Nesosydne incommoda Muir, 1916:193, pl. 3, fig. 47.

Ilburnia incommoda (Muir), of authors.

Endemic. Oahu (type locality: Kaumuohona).

Nesosydne ipomoeicola Kirkaldy (figs. 69, o–q; 82, b).

Delphax pulchra Stål, Öfv. Svenska Vet. Akad. Förh. 11:246, 1854 (I have not seen this reference); 1859:275, redescription (name preoccupied in *Delphax*).

Nesosydne ipomoeicola Kirkaldy, 1907:120; 1908:202, pl. 4, fig. 4; 1910:586. Muir, 1916:194, pl. 3, figs. 51, a–c

Ilburnia ipomoeicola (Kirkaldy) Muir, 1921:517.

Endemic. Kauai, Oahu (type locality: Honolulu), Molokai, Maui, Hawaii.

Hostplants: *Antidesma,* Bermuda grass, *Cibotium, Cyrtandra, Dolichos lablab, Gouldia elongata, Ipomoea bona-nox, Jussiaea villosa,* leafy cabbage, *Lythrum maritimum, Mucuna gigantea, Pipturus, Polygonum,* potato, *Rumex, Sadleria, Strongylodon lucidum,* sweet potato.

Some of these hostplants probably have been recorded on the basis of accidental captures and they do not serve as breeding plants. I have seen long-winged individuals resting on bush beans and lima beans and have seen examples which had been confused with the taro leafhopper because they were caught resting on taro. Swezey found it to be particularly attached to *Sadleria* ferns, in the young, tender frond stalks of which it lays numerous eggs. William Look reported finding eggs abundant in stray Irish potato plants on Hawaii in March, 1945. The species breeds on *Ipomoea.*

This was the first Hawaiian delphacid to be described. It has been collected mostly from 1,500 feet down to sea level. Kirkaldy considered it to be the commonest of the native delphacids. It is a variable species, and Muir thought that it

consisted of a number of varieties or subspecies. Both sexes have short- and long-winged individuals. Some examples examined have the thoracic nota and tegmina largely pale, whereas others have these parts extensively dark and in others they are predominantly or almost entirely black.

Perkins (1913:clxxxiii) said that at least two *Pipunculus* flies are parasitic on this species, but he did not cite their names.

Figure 70— Details of *Nesosydne* genitalia. **a–f**, *N. koae* Kirkaldy: **(a)** head from side; **(b)** right style; **(c)** head from front (beneath) to show convexity of front of vertex; **(d)** aedeagus; **(e)** anal spine; **(f)** right style (d–f, from balsam slide of same example from Mount Tantalus, Oahu). **g–i**, *N. koae-phyllodii* Muir: **(g)** aedeagus; **(h)** anal spine; **(i)** right style (g–i, balsam mount of same example). **j–l**, *N. koebelei* Muir, holotype (parts in balsam): **(j)** left style, full lateral view; **(k)** anal spine; **(l)** aedeagus. **m, n**, *N. kuschei* (Muir), holotype: **(m)** view of pygophore from left side, anal segment turned up and out showing aedeagus (small teeth on aedeagus not shown here); **(n)** right style. **o–q**, *N. kokolau* (Muir), holotype, parts in balsam: **(o)** right style; **(p)** anal spine; **(q)** aedeagus.

Nesosydne koae Kirkaldy (figs. 47, d; 70, a–f).

Nesosydne koae Kirkaldy, 1907:161; 1908:202, pl. 4, fig. 2; 1910:583. Muir, 1916:185, pl. 2, fig. 32 (this figure is misleading); 1917:299. Genotype of *Nesosydne*.

Ilburnia koae (Kirkaldy), of authors.

Endemic. Kauai (?), Oahu (type locality: Mount Tantalus), Hawaii (variety ?).

Hostplant: *Acacia koa*—breeds on the young leaves.

Muir (1917:299) stated that the female "only oviposits in the young shoots bearing leaves..."; he described the ovipositor and compared it with that of *rubescens*. Both nymphs and adults, when living, are the same bright green as the young leaves of koa. Macropterous and brachypterous forms occur in both sexes of this species.

Perkins notes in his letter that Kirkaldy "... named specimens from Hawaii also as *koae* and a similar sp. was in the S.I.C. [Sandwich Islands Committee] coll. from Molokai (taken on *Acacia koaia*) but I do not know what became of the latter." The type is evidently in the British Museum.

Nesosydne koae-phyllodii Muir (fig. 70, g–i).
Nesosydne koae-phyllodii Muir, 1916:186, pl. 2, fig. 31.
Ilburnia koae-phyllodii (Muir), of authors.

Endemic. Kauai (type locality: Waimea), Oahu (variety ?).
Hostplant: *Acacia koa.*
The eggs are deposited in the edges of the koa phyllodes, not in the leaves. Only macropterous forms have been found.

Nesosydne koebelei Muir (figs. 63, a; 70, j–l).
Nesosydne koebelei Muir, 1917:308, pl. 5, figs. 10, 10a.
Ilburnia koebelei (Muir), of authors.

Endemic. Oahu (type locality: Punaluu).

Nesosydne kokolau (Muir), new combination (fig. 70, o–q).
Ilburnia kokolau Muir, 1919:95, pl. 4, figs. 4a, b.

Endemic. Maui (type locality: ridge south of Iao Valley).
Hostplant: *Campylotheca* ("kokolau").

Nesosydne kuschei (Muir), new combination (fig. 70, m, n).
Ilburnia kuschei Muir, 1922:96, pl. 3, fig. 10.

Endemic. Kauai (type locality: near Waialae Falls, 4,000 feet).
Hostplant: *Cyrtandra.*

Nesosydne lanaiensis (Muir), new combination (fig. 71, a, b).
Ilburnia fullawayi subspecies *lanaiensis* Muir, 1917:309.
Ilburnia cyathodis variety *lanaiensis* (Muir) Muir, 1919:92.

Endemic. Lanai (holotype from Waiopaa; allotype from Kaiholena).
Hostplant: *Styphelia* (*Cyathodes*).
This species has been listed as occurring on Maui (Muir, 1919:92), but I am not convinced that it occurs there. I believe that it is specifically distinct from *cyathodis*. It is closely similar to *fullawayi.*

Figure 71—Details of *Nesosydne*. **a, b,** *N. lanaiensis* (Muir), holotype (parts in balsam): **(a)** left style; **(b)** aedeagus. **c–f,** *N. leahi* (Kirkaldy): **(c)** front of head (from beneath) to show protuberant nature of frons and vertex; **(d)** left style in balsam; **(e)** aedeagus in balsam; **(f)** anal spine in balsam. **g–j,** *N. lobeliae* Muir: **(g)** outline of hind margin of pygophore as seen from right; **(h)** left style, full side view; **(i)** anal segment, from side; **(j)** aedeagus.

Nesosydne leahi (Kirkaldy) (fig. 71, c–f).
Megamelus leahi Kirkaldy, 1904:176.
Nesosydne leahi (Kirkaldy) Kirkaldy, 1908:202.
Ilburnia leahi (Kirkaldy), of authors.

Endemic. Oahu (type locality: Diamond Head ["Leahi"]), Kauai (?).
Hostplant: *Lipochaeta calycosa.*
Parasite: *Anagrus frequens* Perkins (Hymenoptera: Mymaridae), in the eggs.
Muir (1916:193, pl. 3, fig. 49) described and figured the male terminalia of a specimen from *Lipochaeta* which may be this or another species. Kirkaldy omitted the species from his 1910 *Fauna Hawaiiensis* report.

Both sexes are represented in collections by macropterous and brachypterous specimens.

Perkins states in his letter: "I believe I still have one or two of the original specimens, captured on the side of Diamond Head on some isolated specimens of its food plant. Kirkaldy could not find these original plants from my direction, but obtained the insect in the crater itself. The specimens he had of mine and of his own were I think nearly all destroyed during the time he was in hospital." The type is presumably in the British Museum.

This species displays a slight indication in the produced vertex of its head that is suggestive of a tendency toward the development of a cephalic horn such as that of *Dictyophorodelphax.*

Nesosydne lobeliae Muir (fig. 71, g–j).
Nesosydne lobeliae Muir, 1916:212; 1917:306, pl. 5, figs. 7, 7a.
Ilburnia lobeliae (Muir) Muir, 1919:108; 1921:520, pl. 8, figs. 3, 3a.

Endemic. Oahu (type locality: Kaumuohona Ridge).
Hostplant: *Lobelia hypoleuca.*

Figure 72—*Nesosydne* genitalia details. **a–d**, *N. longipes* (Muir): (**a**) outline of hind margin of pygophore; (**b**) right style, dry on paratvpe, oblique rear view to side; (**c**) aedeagus in balsam; (**d**) armature of diaphragm in balsam. **e, f**, *N. montis-tantalus* Muir: (**e**) anal segment; (**f**) rear margin of pygophore as seen from left side. **g**, *N. mamake* (Muir), right style in balsam **h**, *N. naenae* (Muir), right style of paratype. **i**, *N. monticola* Kirkaldy, outline of hind margin of pygophore from left side (example compared with type by Perkins). **j–l**, *N. nephelias* Kirkaldy: (**j**) outline of hind margin of pygophore from left side (from a cotype of "*disjuncta*"); (**k**) lateral view of right style; (**l**) full rear view of right style.

Nesosydne longipes (Muir), new combination (fig. 72, a–d).
Ilburnia longipes Muir, 1919:93, pl. 3, fig. 4; pl. 4, fig. 15.

Endemic. Maui (type locality: Olinda, 4,200 feet).
Hostplant: *Cyrtandra mauiensis.*

Nesosydne mamake (Muir), new combination (fig. 72, g).
Ilburnia mamake Muir, 1919:101, pl. 4, fig. 8.

Endemic. Maui (type locality: Waikamoi Gulch, 4,000 feet).
Hostplant: *Pipturus* ("mamake").
Muir described the nymphs.

Nesosydne mauiensis (Muir), new combination (fig. 73, a–d).
Ilburnia mauiensis Muir, 1919:99, pl. 3, fig. 10; pl. 4, fig. 5.

Endemic. Maui (type locality: Wailuku Common).
Hostplants: *Campylotheca mauiensis, Lipochaeta integrifolia, Raillardia menziesii, Tetramolopium artemisia.*

Nesosydne monticola Kirkaldy (fig. 72, i).
Nesosydne monticola Kirkaldy, 1910:591. Muir, 1916:197.
Ilburnia monticola (Kirkaldy) Muir, 1919:90, pl. 4, fig. 10.

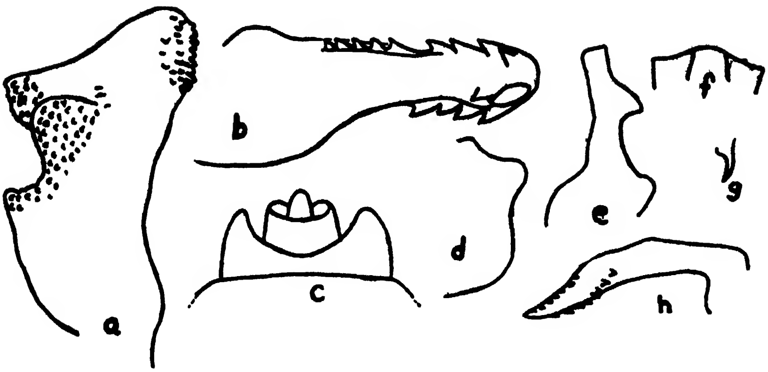

Figure 73—*Nesosydne* genitalia details. **a–d,** *N. mauiensis* (Muir): **(a)** right style, in balsam; **(b)** aedeagus, in balsam; **(c)** pygophore as seen from above; **(d)** outline of hind margin of pygophore as seen from side. **e–h,** *N. neocyrtandrae* (Muir): **(e)** left style in balsam; **(f)** fore margin of vertex as seen from above; **(g)** anal spine, in balsam; **(h)** aedeagus, in balsam.

Endemic. Maui (type locality: Mount Haleakala, 8,000 feet).

Hostplant: *Coprosma montana.*

This is much like *imbricola,* but it is darker, has a shorter first antennal segment and somewhat different terminalia.

The type is supposedly in the British Museum.

Nesosydne montis-tantalus Muir (fig. 72, e, f).

Nesosydne montis-tantalus Muir, 1916:195, pl. 5, fig. 55.

Ilburnia montis-tantalus (Muir), of authors.

Endemic. Oahu (type locality: Mount Tantalus).

Hostplants: *Lobelia hypoleuca, Broussaisia arguta* (reported to be common on small plants and seedlings close to the ground).

Nesosydne naenae (Muir), new combination (figs. 72, h; 82, g).

Ilburnia naenae Muir, 1922:98, pl. 3, fig. 12.

Endemic. Kauai (type locality: Alakai Swamp).

Hostplants: *Dubautia* ("naenae"), *Raillardia.*

Nesosydne neocyrtandrae (Muir), new combination (fig. 73, e–h).

Ilburnia neocyrtandrae Muir, 1919:100, pl. 3, fig. 9; pl. 4, fig. 7.

Endemic. Maui (type locality: Waikamoi Trail, 4,000 feet).

Hostplant: *Gunnera mauiensis.*

"The nymphs have the two median frontal carinae and the first joint of antennae very short, as is usual in the genus; the head, tegminal pads and apical portion of the abdomen are dark, the rest light." (Muir, 1919:100.)

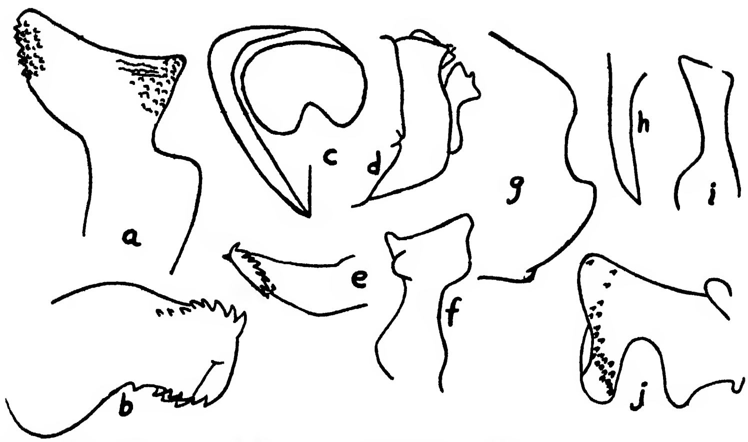

Figure 74—*Nesosydne* details. **a–c**, *N. neoraillardiae* (Muir): **(a)** left style, in balsam as seen with the compound microscope; **(b)** aedeagus, in balsam, under the compound microscope; **(c)** outline of head from side. **d–f**, *N. nephrolepidis* Kirkaldy: **(d)** view of pygophore from left side (outline of style varies with extent it is rotated outward and will not appear the samè unless seen from exactly the same angle); **(e)** aedeagus in balsam; **(f)** right style in balsam. **g**, *N. neowailupensis* (Muir), outline of hind margin of pygophore from left side; **h–j**, *N. nesogunnerae* Muir, holotype: **(h)** anal spine in balsam; **(i)** right style in balsam; **(j)** aedeagus in balsam.

Nesosydne neoraillardiae (Muir), new combination (fig. 74, a–c).
Ilburnia neoraillardiae Muir, 1921:517, pl. 8, fig. 17.

Endemic. Hawaii (type locality: Kahuku, Kau, 1,800 feet).
Hostplant: *Lipochaeta subcordata*.
This species is so close to *raillardiae* that more study is required before an opinion is formed as to the distinctive features between the two. However, the genital styles are less expanded outward on this form.

Nesosydne neowailupensis (Muir), new combination (fig. 74, g).
Nesosydne wailupensis 1916:191, pl. 3, fig. 43; pl. 4, fig. 66 (name preoccupied).
Ilburnia neowailupensis Muir, 1919:108.

Endemic. Oahu (type locality: Wailupe).
Hostplant: *Coprosma longifolia*.
This species has much in common with *gigantea*.

Nesosydne nephelias Kirkaldy (figs. 61, d–f; 63, d, e; 72, j–l).
Nesosydne nephelias Kirkaldy, 1910:588. Muir, 1916:197; 1917:308, pl. 5, fig. 8 (this species ?).
Ilburnia nephelias (Kirkaldy), of authors.
Nesosydne disjuncta Muir, 1917:306, pl. 5, figs. 12, 12a. Synonymy by Muir, 1919:6.

Endemic. Lanai (type locality, 2,000 feet or above).

Kirkaldy's type is in the British Museum. Muir's type of *disjuncta* came from 3,000 feet on Lanai. Kirkaldy's series contained more than one species. A specimen in the Bishop Museum from the original lot is quite different from the holotype, and this may have confused Muir.

Nesosydne nephrolepidis Kirkaldy (fig. 74, d–f).

Nesosydne nephrolepidis Kirkaldy, 1908:203, pl. 4, fig. 1. Muir, 1916:189, pl. 3, fig. 40; pl. 4, fig. 79.

Ilburnia nephrolepidis (Kirkaldy), of authors.

Endemic. Oahu (type locality: Mount Tantalus), Maui, Hawaii.

Hostplant: *Nephrolepis exaltata.*

Nesosydne nesogunnerae Muir (figs. 63, g, h; 74, h–j).

Nesosydne nesogunnerae Muir, 1917:305, pl. 5, figs. 16, 16a.

Ilburnia nesogunnerae (Muir), of authors.

Endemic. Lanai (type locality: Lanaihale, 3,000 feet).

Nesosydne nesopele (Muir), new combination (fig. 75, a–d).

Ilburnia nesopele Muir, 1921:511, pl. 8, figs. 6, 6a.

Endemic. Maui (type locality: Ukulele Pipe Line, Haleakala, 5,000 feet).

Hostplant: *Astelia veratroides.*

Muir described the nymphs as being "yellow, brown on face, clypeus, wing pads, hind femora and apical tarsi."

Nesosydne nigriceps Muir (figs. 63, b; 75, e–g).

Nesosydne nigriceps Muir, 1917:308, pl. 6, figs. 33, 33a.

Ilburnia nigriceps (Muir) Muir, 1921:511, pl. 8, fig. 7, aedeagus (*"nigroceps"*).

Endemic. Lanai (type locality: 2,300 feet).

Nesosydne nigrinervis (Muir), new combination (fig. 75, h, i).

Ilburnia cyathodis variety *nigrinervis* Muir, 1919:92.

Endemic. Maui (type locality: Mount Haleakala).

Hostplant: *Styphelia* (*Cyathodes*).

This is a very dark or black form, and I consider it to be fully specifically distinct from *cyathodis*. The males are only about 1.5 mm. long although they appear larger. It has been taken in series at the summit of Haleakala (10,000 feet).

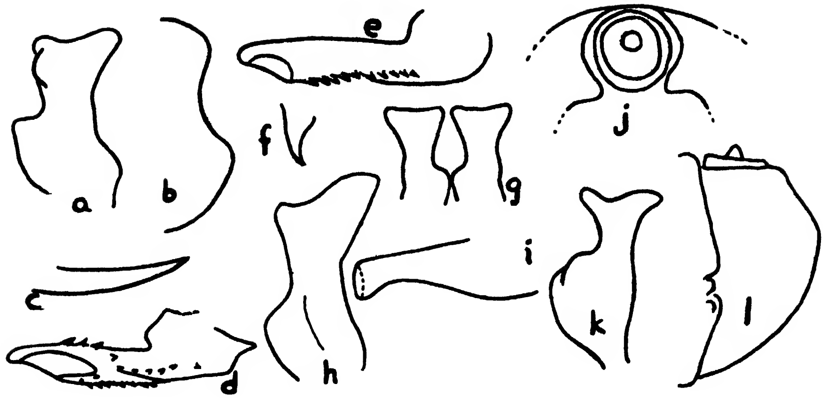

Figure 75—Details of *Nesosydne* genitalia. **a–d**, *N. nesopele* (Muir): **(a)** right style in balsam; **(b)** outline of hind margin of pygophore of holotype; **(c)** anal spine in balsam; **(d)** aedeagus in balsam. **e–g**, *N. nigriceps* Muir: **(e)** aedeagus of holotype in balsam; **(f)** anal style of holotype in balsam; **(g)** genital styles in balsam. **h, i**, *N. nigrinervis* (Muir): **(h)** right style in balsam; **(i)** aedeagus in balsam. **j–l**, *N. oahuensis* Muir: **(j)** anal segment and surrounding anal angles of pygophore; **(k)** right style in balsam; **(l)** lateral view of pygophore.

Nesosydne nubigena Kirkaldy (fig. 61, a–c).
Nesosydne nubigena Kirkaldy, 1910:589.
Ilburnia nubigena (Kirkaldy), of authors.

Endemic. Molokai (type locality: "forest above Pelekunu").
The type is in the British Museum. I have not seen this species, but the illustrations show that it is a distinctive form. The tooth-like process on the sides of the male pygophore above the medio-ventral process recalls the similar processes on *Nesosydne sola*. The ventro-median process on this species is broad and blunt (as seen from above), but on *sola* it is pointed in both dorsal and lateral views.

Nesosydne oahuensis Muir (fig. 75, j–l).
Nesosydne oahuensis Muir, 1916:188, pl. 2, fig. 37.
Ilburnia oahuensis (Muir), of authors.

Endemic. Oahu (type locality: Mount Tantalus).
Hostplant: *Charpentiera obovata.*

Nesosydne olympica (Muir), new combination (fig. 76, a–d).
Ilburnia olympica Muir, 1921:520, pl. 8, figs. 16, a, b.

Endemic. Oahu (type locality: Castle Trail, about 2,000 feet).
Hostplant: *Lobelia.*
This distinctive species evidently lacks anal spines.

Figure 76—*Nesosydne* genitalia. **a–d,** *N. olympica* (Muir): **(a)** pygophore as seen from above, holotype; **(b)** outline of hind margin of pygophore as seen from left side, holotype; **(c)** right style obliquely from side, holotype; **(d)** aedeagus in balsam. **e–h,** *N. osborni* Muir: **(e)** left style of holotype, dry; **(f)** left style as seen in balsam preparation; **(g)** aedeagus in balsam; **(h)** anal spine in balsam. **i–k,** *N. painiu* (Muir), holotype, parts in balsam: **(i)** anal spine; **(j)** right style; **(k)** aedeagus. **l,** *N. palustris* Kirkaldy, hind margin of pygophore as seen from side.

Nesosydne osborni Muir (fig. 76, e–h).

Nesosydne osborni Muir, 1916:192, pl. 3, fig. 46 (this figure erroneous).
Ilburnia osborni (Muir) Muir, 1919:99, pl. 4, fig. 6.

Endemic. Maui (type locality: Haleakala Crater).
Hostplant: *Raillardia.*

Nesosydne bridwelli is identical in external appearance with this species, but the aedeagus is broadly expanded at the apex in the holotype of *N. osborni,* whereas it is narrowed to a slender apex on the holotype of *bridwelli.* These differences are also evident on other examples studied, but the shape of the aedeagus is somewhat variable. It is obvious that the two forms are closely allied, and more information regarding them is desirable. I have taken typical *bridwelli* breeding commonly on *Dubautia* or *Raillardia.*

Nesosydne painiu (Muir), new combination (fig. 76, i–k).

Ilburnia painiu Muir, 1919:102, pl. 4, fig. 16, *a–c.*

Endemic. Maui (type locality: ridge south of Iao Valley).
Hostplant: *Astelia veratroides* ("painiu").

Nesosydne palustris Kirkaldy (fig. 76, l).

Nesosydne palustris Kirkaldy, 1908:202, pl. 4, fig. 7; 1910:589.
Ilburnia palustris (Kirkaldy), of authors.

Endemic. Molokai (type locality: 4,500–4,950 feet; high, wet bog).

Nesosydne perkinsi Muir (figs. 78, d; 82, c, h).
Nesosydne perkinsi Muir, 1916:190, pl. 3 (not pl. 2 as stated in original description), fig. 42; pl. 4, fig. 73.
Ilburnia perkinsi (Muir), of authors.

Endemic. Maui (type locality: Mount Haleakala, 5,000 feet).

Nesosydne phyllostegiae Muir (fig. 78, e–h).
Nesosydne phyllostegiae Muir, 1918:405, figs. 3, 4.
Ilburnia phyllostegiae (Muir), of authors.

Endemic. Hawaii (type locality: Puuwaawaa, North Kona, 3,700 feet).
Hostplant: *Phyllostegia racemosa.*
Macropterous females and brachypterous males and females are known.

Nesosydne pilo (Muir), new combination (fig. 78, i–k).
Ilburnia pilo Muir, 1922:99, pl. 3, figs. 14, 14a.

Endemic. Maui (type locality: Haleakala, 5,800 feet).
Hostplant: *Coprosma ernodioides* ("pilo").
Brachypterous males and females and macropterous females have been reported. This species is very close to *imbricola,* but the styles have a rounded boss on their inner sides which is distinct from that of *imbricola.*

Nesosydne pipturi Kirkaldy (fig. 78, l–n).
Nesosydne pipturi Kirkaldy, 1908:202, pl. 4, fig. 3; 1910:584. Muir, 1916:191, pl. 3, fig. 45.
Ilburnia pipturi (Kirkaldy) Muir, 1921:515, pl. 8, figs. 11, 11a.

Endemic. Oahu (type locality: the mountains behind Waialua, according to Perkins' letter).
Hostplant: *Pipturus.*
Parasite: *Pipunculus swezeyi* Perkins (Diptera: Pipunculidae).
The type should be in the British Museum.
The nymphs are pale green. This species and *boehmeria* are very similar.

Nesosydne procellaris Kirkaldy (fig. 62, a).
Nesosydne procellaris Kirkaldy, 1910:588. Muir, 1916:197.
Ilburnia procellaris (Kirkaldy), of authors.

Endemic. Molokai (type locality: above Pelekunu, 3,000 feet).
This is a large species (4.5 mm. in length), and it does not seem to have been collected since the type pair was taken by Perkins. What I have taken to be

the female specimen from the original material has been found in the Bishop Museum. I have labeled it "Allotype ?" and placed it in the type collection. The number beneath the card on which the specimen is mounted refers to Perkins' collecting area at 3,000 feet, above Pelekunu, Molokai. The holotype is in the British Museum, and, as the drawing included here shows, it is a broken specimen. Kirkaldy stated that it was the bulkiest of the Hawaiian delphacids known to him. I do not know why he should have stated that "This species is very probably now extinct." The type material came from a locality which has been poorly collected. From the included drawing, it may appear that the type is macropterous, but it is a brachypterous form, the tegmina of which do not reach to the apex of the abdomen in the male but surpass it in the female.

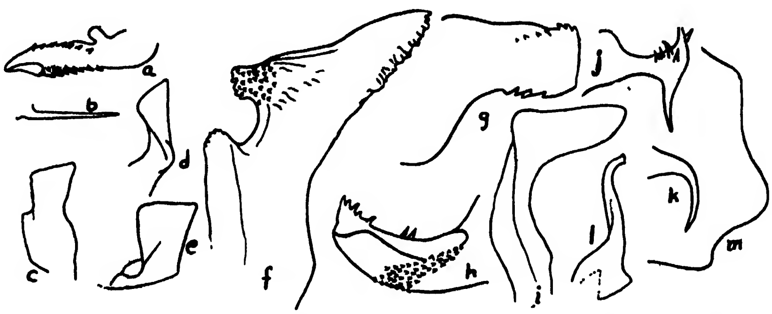

Figure 77—Details of *Nesosydne* genitalia. **a–e,** *N. pseudorubescens* Muir: (**a**) aedeagus in balsam; (**b**) anal spine in balsam; (**c**) right style in balsam; (**d**) right style on holotype viewed obliquely from the inside (left side), dry; (**e**) the same, in direct rear view. **f, g,** *N. raillardiae* Kirkaldy, parts in balsam under the compound microscope: (**f**) right style; (**g**) aedeagus. **h, i,** *N. rocki* Muir, holotype: (**h**) aedeagus, dry dissection; (**i**) right style from right side. **j–m,** *N. sharpi* Muir, holotype, dry dissection: (**j**) aedeagus; (**k**) anal spine; (**l**) full left view of left style; (**m**) outline of hind margin of pygophore as seen from side.

Nesosydne pseudorubescens Muir (fig. 77, a–e).

Nesosydne pseudorubescens Muir, 1916:186, pl. 2, fig. 34.
Ilburnia pseudorubescens (Muir) Muir, 1919:88.
Nesosydne pele, misidentification by Muir, 1916:188, pl. 2, fig. 36; pl. 4, fig. 78.
Ilburnia pele, misidentification by Muir, 1921:512, pl. 8, figs. 9, 9a.

Endemic. Maui, Hawaii (type locality: Olaa, 29 miles).

Hostplants: *Acacia koa* (on the phyllodes); *Lobelia* and *Clermontia parviflora,* accidental (?) captures.

Muir did not see Kirkaldy's type of *pele,* and he confused with it the broad-styled species he called *pseudorubescens.* The styles bend cephalad at about the middle, and this angulation confused Muir into considering that each had a pyramidal projection on the posterior face as he illustrated for *"pele"* (1916:221, pl. 4, fig. 78). I have examined the original material which Muir called *"pele,"* including the slide of the genitalia which served as a basis for his illustration, and find it to be the same as the type of *pseudorubescens.*

"In coloration this species is very similar to *rubescens*, but the fuscous hind margin from clavus to apex is very distinctive...." (Muir, 1916:186.) I believe that this dark coloration is individually variable. Only macropterous males and females have been reported.

Nesosydne raillardiae Kirkaldy (fig. 77, f, g).

Nesosydne raillardiae Kirkaldy, 1908:203, pl. 4, fig. 5; 1910:590. Muir, 1916: 194, pl. 3, fig. 50.

Ilburnia raillardiae (Kirkaldy) Muir, 1921:516, pl. 8, fig. 18.

Endemic. Hawaii (type locality: Kilauea, 4,000 feet).

Hostplants: *Raillardia scabra, Raillardia ciliolata, Rollandia.*

Macropterous females have been found in addition to the short-winged males and females. The type should be in the British Museum. This is close to *neo-raillardiae.*

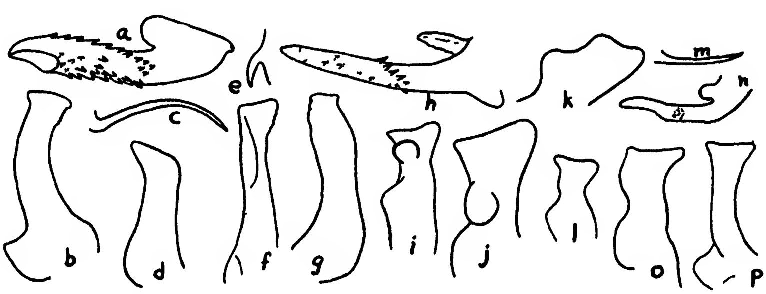

Figure 78—Details of *Nesosydne* genitalia. **a–c**, *N. rubescens pele* (Kirkaldy), parts in balsam: **(a)** aedeagus (the number and arrangement of the teeth is subject to individual variation); **(b)** right style; **(c)** anal spine. **d**, *N. perkinsi* Muir, right style of holotype. **e–h**, *N. phyllostegiae* Muir: **(e)** anal spine of holotype in balsam; **(f)** right style of paratype, from rear, dry; **(g)** left style of holotype, flat in balsam; **(h)** aedeagus in balsam. **i–k**, *N. pilo* (Muir): **(i)** right style of paratype as seen in balsam; **(j)** right style as seen from behind; **(k)** right style as seen obliquely from side. **l–n**, *N. pipturi* Kirkaldy, parts in balsam: **(l)** right style; **(m)** anal spine; **(n)** aedeagus. **o**, *N. raillardiicola* (Muir), right style. **p**, *N. rubescens* (Kirkaldy), right style oblique from side.

Nesosydne raillardiicola (Muir), new combination (fig. 78, o).

Ilburnia raillardiicola Muir, 1919:102, pl. 4, fig. 14; 1921:512, pl. 8, fig. 5.

Endemic. Maui (type locality: Mount Haleakala, 7,000–8,000 feet).

Hostplants: *Raillardia menziesii, Raillardia platyphyllum.*

Muir (1919:102) described the nymphs as being "ochraceous orange, brownish over the head and thorax."

Nesosydne rocki Muir (fig. 77, h, i).

Nesosydne rocki Muir, 1916:196, pl. 3, fig. 56; pl. 4, fig. 71, a, b.

Ilburnia rocki (Muir), of authors.

Endemic. Oahu (type locality: Konahuanui).

Nesosydne rubescens (Kirkaldy) (fig. 78, p).
Nesosydne koae variety *rubescens* Kirkaldy, 1907:161; 1910:584.
Nesosydne rubescens (Kirkaldy) Muir, 1916:185, pl. 2, fig. 30.
Ilburnia rubescens (Kirkaldy), of authors.

Endemic. Kauai, Oahu (type locality: Mount Tantalus), Maui, Hawaii.

Hostplant: *Acacia koa* (eggs deposited in edges of leaves and phyllodes).

Kirkaldy (1910:584) says that the nymphs are green tinged with roseate. Only macropterous males and females are known.

If a holotype were ever designated, it should be in the British Museum.

Nesosydne rubescens variety **pele** (Kirkaldy), new combination (fig. 78, a–c).
Nesosydne pele Kirkaldy, 1910:585.
Nesosydne rubescens variety *pulla* Muir, 1916:186.
Ilburnia rubescens variety *pulla* (Muir), of authors.
Muir's *Nesosydne pele,* 1916:188, pl. 2, fig. 36; pl. 4, fig. 78, and his *Ilburnia pele,* 1921:512, pl. 8, figs. 9, 9*a,* apply to *pseudorubescens.*

Endemic. Hawaii (type locality: Kilauea).

Hostplant: *Acacia koa* (also recorded, probably from accidental captures or misidentifications, from *Broussaisia pellucida, Cyrtandra* and *Platydesma campanulata*).

This is a darker form; the males have dark, nearly black, mesonota. Only macropterous males and females have been reported. Further study is needed to elucidate the status of the forms of this species. It might be questioned whether the supposed varietal differences are stable or whether they represent individual or colonial variation.

The type mount, which consists of two male examples on the same card, is now in the Bishop Museum. Muir was misled (perhaps by a specimen which was considered a cotype of this species but actually was *pseudorubescens*) and redescribed this species under the name *pulla.* He did not see the type, and he could not obtain adequate information from Kirkaldy's description.

This variety is named for Pele, the Hawaiian goddess of the volcano.

Nesosydne sharpi Muir (fig. 77, j–m).
Nesosydne sharpi Muir, 1916:195, pl. 3, fig. 53, a, b; pl. 4, fig. 65.
Ilburnia sharpi (Muir), of authors.

Endemic. Oahu (type locality: Punaluu).

Hostplants: *Broussaisia, Boehmeria stipularis.*

Nesosydne sola Muir (figs. 63, c; 79, a).
Nesosydne sola Muir, 1917:307, pl. 5, figs. 11, 11*a.*
Ilburnia sola (Muir), of authors.

Endemic. Oahu (type locality: Punaluu).

See the comparative notes under *nubigena.* This is a peculiar species with an unusual aedeagus and an elongate anal segment.

Nesosydne stenogynicola (Muir), new combination (fig. 79, b, c).
Ilburnia stenogynicola Muir, 1919:94, pl. 3, fig. 5; pl. 4, fig. 22.

Endemic. Maui (type locality: Olinda, 4,200 feet).
Hostplant: *Stenogyne kamehameha.*

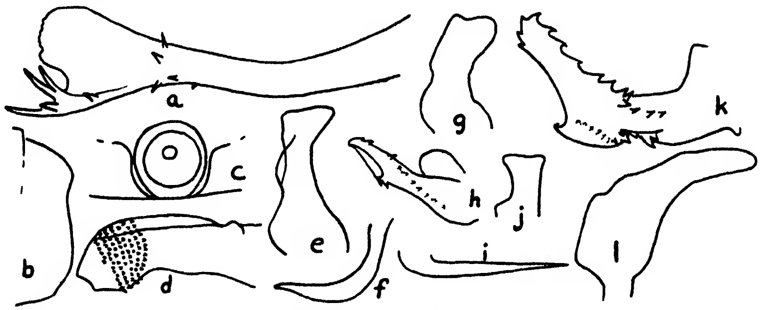

Figure 79—*Nesosydne* genitalia details. **a,** *N. sola* Muir, aedeagus, holotype, dry dissection; **b, c,** *N. stenogynicola* (Muir), paratype: **(b)** outline of hind edge of pygophore from side; **(c)** anal segment as seen from above. **d–f,** *N. sulcata* (Muir), holotype, parts in balsam: **(d)** aedeagus; **(e)** right style; **(f)** right anal spine. **g–i,** *N. swezeyi* Muir, holotype, dry dissection: **(g)** right style; **(h)** aedeagus; **(i)** anal spine. **j,** *N. tetramolopii* (Muir), holotype, upper part of right style. **k, l,** *N. timberlakei* Muir, holotype, parts in balsam: **(k)** aedeagus; **(l)** right style.

Nesosydne sulcata (Muir), new combination (fig. 79, d–f).
Ilburnia sulcata Muir, 1921:516, pl. 8, fig. 4.

Endemic. Maui (type locality: ditch trail east of Keanae, about 1,500 feet).
Hostplant: *Cyrtandra.*

Nesosydne swezeyi Muir (figs. 79, g–i; 82, d).
Nesosydne swezeyi Muir, 1916:187, pl. 2, fig. 33; pl. 4, fig. 68.
Ilburnia swezeyi (Muir), of authors.

Endemic. Oahu (type locality: Mount Olympus).

Nesosydne tetramolopii (Muir), new combination and emendation (figs. 79, j; 81, d).
Ilburnia tetramalopii Muir, 1919:88, pl. 3, fig. 7; pl. 4, fig. 19.

Endemic. Maui (type locality: Mount Haleakala, 7,000 feet).
Hostplant: *Tetramolopium humile.*
The nymphs are described by Muir.
A typographical error in the original description makes the change in spelling of the specific name necessary.

Nesosydne timberlakei Muir (fig. 79, k, l).
Nesosydne timberlakei Muir, 1917:304, pl. 5, fig. 14; 1918:398.
Ilburnia timberlakei (Muir), of authors.

Endemic. Oahu (type locality: Waiahole).
Hostplants: *Cyrtandra garnotiana, Cyanea truncata.*

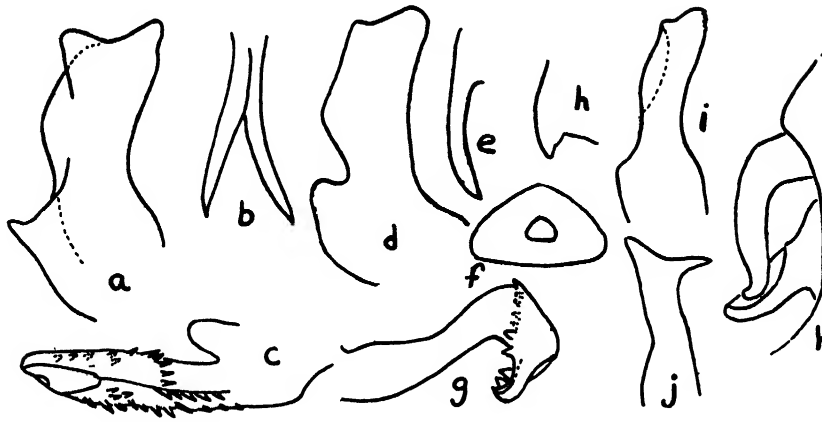

Figure 80—Details of *Nesosydne* genitalia. **a–c,** *N. ulehihi* (Muir), parts in balsam: **(a)** right style; **(b)** anal spines; **(c)** aedeagus. **d–g,** *N. umbratica* Kirkaldy: **(d)** right style, drawn flat in fluid; **(e)** anal spine in balsam; **(f)** anal segment; **(g)** aedeagus in balsam. **h, i,** *N. viridis* (Muir), paratype, parts in balsam: **(h)** anal spine; **(i)** right style, viewed from flat side (it appears longer and narrower when seen from behind). **j, k,** *N. wailupensis* (Muir): **(j)** right style; **(k)** side view of part of pygophore to show aedeagus and armature of diaphragm.

Nesosydne ulehihi (Muir), new combination (fig. 80, a–c).
Ilburnia ulehihi Muir, 1919:104, pl. 4, fig. 12.

Endemic. Hawaii (type locality: Olaa, 27 miles).
Hostplant: *Smilax sandwicensis* ("ulehihi").

Nesosydne umbratica Kirkaldy (fig. 80, d–g).
Nesosydne umbratica Kirkaldy, 1910:585.
Ilburnia umbratica (Kirkaldy), of authors.
Nesosydne blackburni Muir, 1916:189, pl. 3, fig. 41; pl. 4, fig. 70, a, b. New synonym.
Ilburnia curvata Muir, 1919:96, pl. 4, figs. 1, 3. New synonym.

Endemic. Oahu, Maui, Hawaii (type locality: Kilauea).
Hostplants: *Charpentiera obovata, Clermontia* (several species), *Cyrtandra, Pipturus, Stenogyne, Urera sandwicensis.*

This species has not been recognized under Kirkaldy's name since it was described. The types, however, are in the Bishop Museum, and I have found the above synonymy necessary. When Muir described his *blackburni* (1916:190) he said, "It is possible that this is *umbratica* Kirkaldy, but the description is useless for identification." The holotype mount of *blackburni* consists of two female examples, and there are two additional female specimens in Perkins' collection at the Bishop Museum. I have compared female paratypes of *blackburni* with these female examples and have found them to be conspecific. Kirkaldy did not mention the sex of his specimens, the locality or the hostplant in his brief and unsatisfactory original description. The types were collected from *Clermontia* by Perkins at Kilauea in July, 1906.

Muir's type of *blackburni* came from Kilauea, Hawaii. Muir's *curvata* (described from a unique male from Lupe Ditch Trail, 1,200 feet, Kailua District, Maui) was separated from *blackburni* because of differences in the shape of the apex of the aedeagus. However, the holotype is somewhat teneral, the genitalia evidently have been boiled too long in caustic potash and they are distorted. The anal spines are badly deformed, and, in my opinion, the apex of the aedeagus is also damaged. I have examined several slides of cleared genitalia of "*blackburni*" and have found no two individuals exactly alike. I can find no characters on the holotype of *curvata* to warrant its separation from the series of examples of *umbratica* which have been assembled.

This is a variable species, and the wings may be almost entirely clear or they may be nearly entirely fuscous. Macropterous and brachypterous forms have been reported for both sexes.

Nesosydne viridis (Muir), new combination (fig. 80, h, i).
Ilburnia viridis Muir, 1922:99, pl. 3, figs. 13, 13a.

Endemic. Kauai (type locality: Nualolo).
Hostplant: *Phyllostegia*.

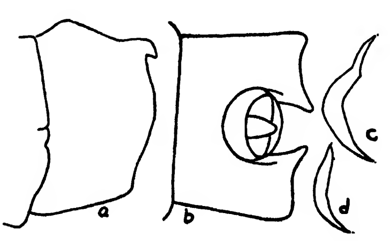

Figure 81—Details of *Nesosydne* genitalia. **a, b**, *N. waikamoiensis* (Muir): **(a)** outline of pygophore as seen from right side; **(b)** outline of pygophore as seen from directly above. **c**, outline of left side of pygophore of *N. bridwelli* (Muir), as seen from behind. **d**, the same of *N. tetramolopii* (Muir).

Nesosydne waikamoiensis (Muir), new combination (fig. 81, a, b).

Ilburnia waikamoiensis Muir, 1919:97, pl. 3, figs. 1, 8; 1921:514, pl. 8, fig. 2 (correction of former figure).

Endemic. Maui (type locality: Waikamoi Gulch, 4,000 feet).

Hostplants: *Cyanea aculeatiflora, Pipturus.*

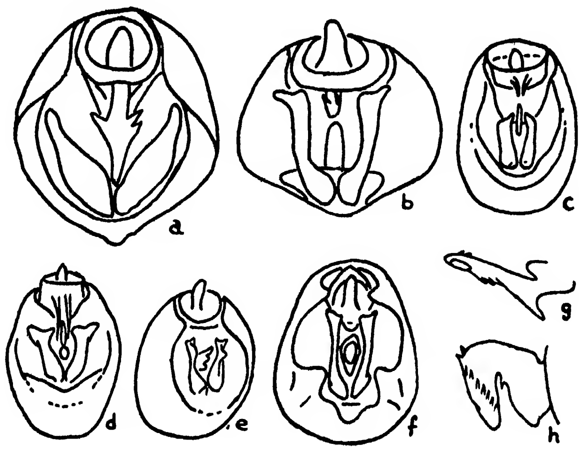

Figure 82—Rough sketches of male genitalia of some *Nesosydne* species. **a,** *N. halia* Kirkaldy, rear view of pygophore; **b,** the same of *N. ipomoeicola* Kirkaldy; **c,** the same of *N. perkinsi* Muir; **d,** the same of *N. swezeyi* Muir; **e,** three-quarters view of pygophore of *N. cyrtandrae* Muir (the aedeagus is incorrectly shown, see fig. 67, e); **f,** rear view of pygophore of *N. giffardi* Muir; **g,** aedeagus of *N. naenae* (Muir); **h,** aedeagus of *N. perkinsi* Muir. (**a, b,** original; c–f, **h,** after Muir, 1916; **g,** after Muir, 1922.)

Nesosydne wailupensis (Muir), new combination (fig. 80, j, k).

Aloha wailupensis Muir, 1916:181, pl. 2, fig. 22.

Ilburnia wailupensis (Muir) Muir, 1919:108.

Endemic. Oahu (type locality: Wailupe).

Hostplant: *Rollandia crispa.*

The aedeagus turns downward at nearly a right angle so that its apex lies against the peculiarly elongated armature of the diaphragm which is hollowed out on its dorsum and projects back between the bases of the styles—an unusual combination of characters.

Tribe DELPHACINI Lambertie, 1910

Araeopini Metcalf, 1938:299.

With the exception of the native species of *Kelisia,* the members of this tribe found in Hawaii are immigrants. The group may be distinguished from the Alohini by the structure and form of the metatibial calcar. In the Delphacini, the calcar, instead of being solid and transversely convex, is either more or less foliaceous or thin, or partly so, or it is distinctly concave on one side. The teeth are reduced to minute dentes and form a minutely denticulate margin on the calcar as figure 46, a, b, indicates.

With the exception of the species of *Megamelus,* which feeds on water lilies, and *Tarophagus,* which feeds on taro, all our Delphacini are attached to grasses—in sharp contrast to the Alohini, none of which feeds on grasses.

Key to the Genera of Delphacini Found in Hawaii

1. First and second antennal segments flattened, the first subtriangular in outline............... **Perkinsiella** Kirkaldy.
   First and second antennal segments subcylindrical, not compressed 2

2(1). Median carina of frons forking at a point near lower edges of eyes........................ **Peregrinus** Kirkaldy.
   Median frontal carina forking on, or close to, the vertex.... 3

3(2). Taro- and water-lily-infesting species; prothorax nearly twice as broad as head across eyes and/or predominantly dark-colored species; first antennal segment obviously longer than broad, two-thirds as long as second or longer 4
   Pallid (except in some examples of *Liburnia*), grass-feeding species; pronotum less than one-fourth broader than head across eyes; first antennal segment only slightly longer than broad, always much shorter than second..... 5

4(3). Taro-frequenting species; median carinae of head very slightly protuberant at apex of vertex, and head not strongly prolonged beyond eyes, as in figure 90 (our species with pro- and mesonotum pale yellow between carinae so as to form a common, broad, pale vitta conspicuous to the unaided eyes and with a similar vitta on last two or three abdominal tergites; tegmina shiny; pronotum only about one-seventh broader than head across eyes; spur of hind tibia V-shaped in cross section; first antennal segment comparatively slender—7:4, male, 10:4, female)............... **Tarophagus,** new genus.
   Water-lily species; median carinae of head strongly protuberant at fore edge of vertex and head prolonged in front of eyes, as in figure 90 (our species with head, across eyes, only about five-eighths as broad as pro-

notum; pro- and mesonotum not conspicuously bicolored as in *Tarophagus;* first antennal segment stout (7:5); tegmina appearing minutely granular; hind tibial spur very large and broad, broadly C-shaped in cross section, leaf-like) .... **Megamelus** Fieber.

5(3). Antennae without dark vittae, at most first segment with a dark apical ring; anal segment of male entire, not concave beneath, with anal spines arising from a common median point and close together; anal angles of pygophore projecting behind anal segment; genital styles expanded distad .... **Liburnia** Stål.

Antennae, as seen from front, with dark vittae; anal segment of male conspicuously concave beneath, with long, strong anal spines widely separated at their origins; anal angles of pygophore not projecting behind anal segment; genital styles attenuated and apically pointed .... **Kelisia** Fieber.

Genus **PERKINSIELLA** Kirkaldy, 1903:179

This genus was originally erected to receive the infamous sugarcane leafhopper. It now contains 23 described species, and it is believed that a number of new species await discovery. The center of development of the genus lies in the Malay Archipelago, and species occur naturally as far west as India and as far east as Fiji. Some species have been spread by man accidentally as far as Africa and eastward to Hawaii. Kirkaldy considered the genus a derivative of the world-wide *Dicranotropis* Fieber. It bears a remarkable superficial resemblance to the American genus *Stobaera* Stål, and this led Kirkaldy (1907:135, footnote) to say that the two genera were closely allied. This statement may cause some confusion, however, for the two genera are now considered as belonging to different tribes. The species are almost exclusively attached to sugarcane and only occasionally do they take to other grasses. A list of the species together with bibliographic references to scores of published writings on the group is included in Metcalf's catalogue (1943) of the family.

This genus is easily recognized in the Hawaiian insect fauna because of its expanded and flattened antennal segments, the first of which is subtriangular in outline. There are other characters which widely separate the genus from other local Delphacini, but they need not all be detailed here. The male terminalia are distinctive. The median part of the ventral caudal margin of the pygophore is produced into a process which in turn bears a pair of spiniform processes. Brachypterous and macropterous forms occur in both sexes in some species. In *Perkinsiella saccharicida* no true brachypterous males have yet been discovered—Giffard's record (1922:109) to the contrary is evidently in error.

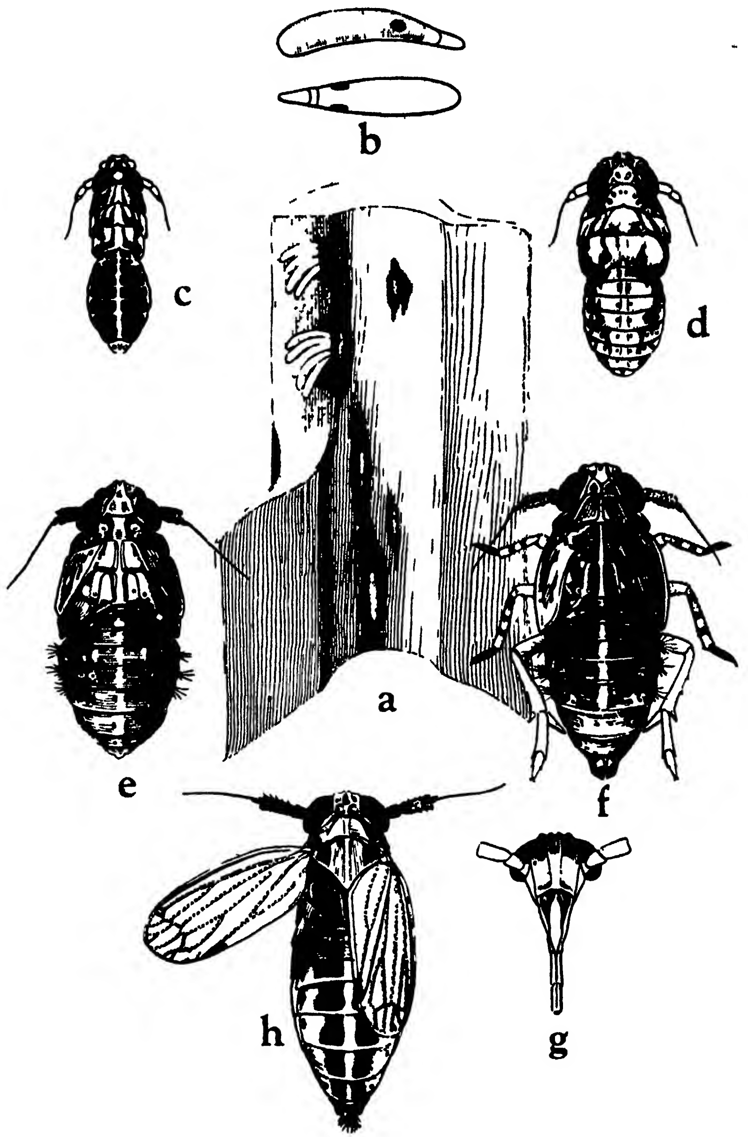

Figure 83—*Perkinsiella saccharicida* Kirkaldy, the sugarcane leafhopper. **a**, section of sugarcane midrib showing eggs in place; **b**, eggs; **c**, first instar nymph; **d**, second instar; **e**, third instar; **f**, fourth instar; **g**, face of fourth instar nymph; **h**, brachypterous adult female. (After Kirkaldy, 1906.)

Perkinsiella saccharicida Kirkaldy (figs. 46, b; 83, a–h; 84, a–f; 85).

Perkinsiella saccharicida Kirkaldy, 1903:179. Genotype.

Kirkaldy, 1906:406, pl. 26, pl. 27, figs. 1–5; 277–286, notes. 1907:137, pl. 11, figs. 5–8; pl. 13, figs. 11–13.

For detailed bibliography, see Metcalf, 1943:137–141.

The sugarcane leafhopper (Hawaiian name: "umu-ko").

Kauai, Oahu (type locality: Honolulu), Molokai, Lanai, Maui, Hawaii.

Immigrant. First found in the Territory by Perkins, who collected it at a light at Waialua, Oahu, in 1900. Perkins (1903:6) considered that it had gained a foothold in the islands in 1897 or 1898. It is a widespread species now recorded from Queensland, New South Wales, Java, Formosa, Malaya, South China, Mauritius and South Africa. It is considered to be a Queensland insect. (Metcalf, 1943:137–141, has erroneously recorded the species from Amboina and the Philippines. The record for Fiji is based upon a single example, probably mislabeled. Considerable collecting in Fiji has failed to reveal the species there.)

Hostplants: sugarcane (Pemberton, 1919:194, reported finding the leafhopper breeding in seven grasses and three sedges on the island of Hawaii, but the identities of the plants, other than "Hilo grass" and *Paspalum conjugatum,* are not available now).

Parasites: *Paranagrus optabilis* Perkins, *Paranagrus perforator* Perkins, *Anagrus frequens* Perkins (Hymenoptera: Mymaridae); *Ootetrastichus beatus* Perkins, *Ootetrastichus formosanus* Timberlake (Hymenoptera: Eulophidae), all in the eggs. *Haplogonatopus vitiensis* Perkins (attacks the nymphs, seldom the adults), *Pseudogonatopus hospes* Perkins (attacks the adults, only rarely the nymphs), *Echthrodelphax fairchildii* Perkins (Hymenoptera: Dryinidae) (attacks the nymphs). *Pipunculus hawaiiensis* Perkins, *Pipunculus juvator* Perkins, and *Pipunculus terryi* Perkins (Diptera: Pipunculidae) parasitize the young leafhoppers.

Predators: *Cyrtorhinus mundulus* (Breddin) (Heteroptera: Miridae) sucks the eggs (see vol. 3, page 206, for discussion). *Conocephalus saltator* (Saussure) (Orthoptera: Tettigoniidae) feeds on nymphs and adults. *Chelisoches morio* (Fabricius) and *Euborellia annulipes* (Lucas) (Dermaptera) feed upon the nymphs and adults. *Zelus renardii* Kolenati (Heteroptera: Reduviidae) attacks nymphs and adults; *Nabis capsiformis* Germar and *Nabis blackburni* White (Heteroptera: Nabidae) feed upon the nymphs and adults, particularly on the nymphs; *Orius persequens* (White) and *Physopleurella mundula* (White) (Heteroptera: Anthocoridae) prey upon the nymphs; *Oechalia kaonohi* Kirkaldy (confused in literature under the name of *Oechalia grisea*) (Heteroptra: Pentatomidae). *Chrysopa microphya* McLachlan, *Anomalochrysa deceptor* Perkins, *Anomalochrysa gayi* Perkins, *Anomalochrysa proteus* Perkins and *Anomalochrysa raphidioides* Perkins (Neuroptera: Chrysopidae) feed upon the nymphs, particularly. *Nesomimesa hawaiiensis* Perkins (Hymenoptera: Mimesidae) stores its burrow nests with adult leafhoppers which it stings and paralyzes.

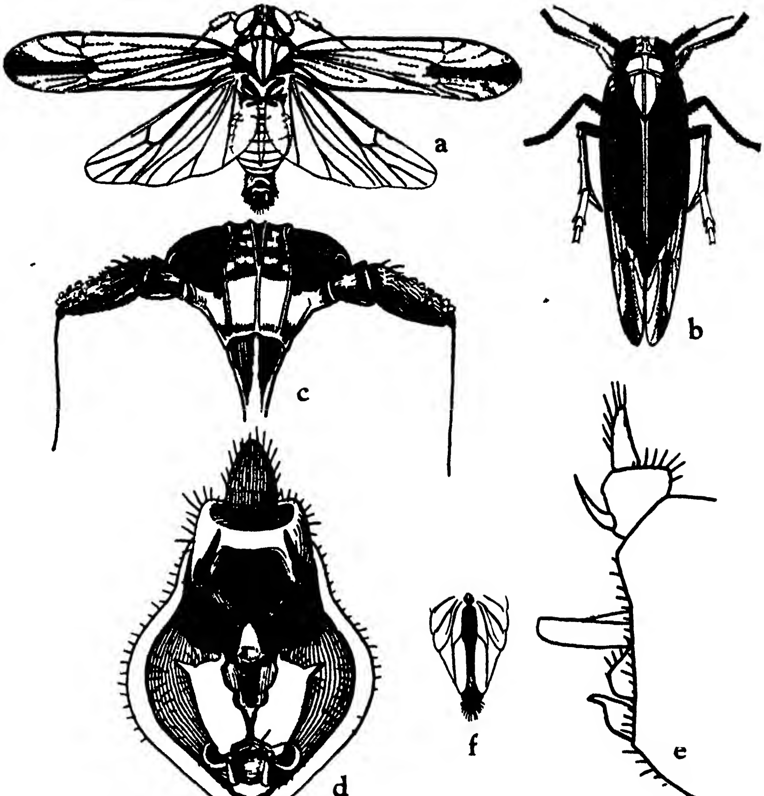

Figure 84—*Perkinsiella saccharicida* Kirkaldy. The sugarcane leafhopper. a, macropterous male; b, macropterous female; c, face; d, rear view of male pygophore; e, outline of male pygophore from side; f, ventral view of apical part of abdomen of female. (Rearranged from Kirkaldy, 1906 and 1907.)

A number of spiders have been recorded as feeding upon the leafhopper. Among these are *Pagiopalus atomarius* Simon, *Tetragnatha mandibulata* Walckenaer, *Heteropoda regia* (Fabricius), *Adrastidea nebulosa* Simon, *Plexippus paykulli* (Audouin), *Hasarius adansoni* (Audouin), *Mollica microphthalmus* (Koch) and *Bavia aericeps* Simon.

Entomophthora, Cordyceps and *Sporotrichium* fungi have been identified as attacking the leafhopper, especially in the regions of heavier rainfall.

Detailed notes on most of the above-listed parasites and predators have been assembled by Swezey in his paper on the "Biological Control of the Sugarcane Leafhopper in Hawaii" (1936), and the reader is referred to that paper for a detailed discussion. His records of parasites and predators refer to the time of great abundance of the leafhopper.

Life history: A clutch of one to as many as 12 slender, curved, whitish eggs is deposited in a slit cut by the ovipositor into the midrib of a leaf (the favorite

place for oviposition), in the internode of a stalk, in a leaf sheath, in a leaf blade or in a shoot. One female may lay as many as 300 eggs in the month or two of her adult life. Although eggs may be deposited in both sides of a leaf, the preferred place of oviposition is low down on the inner (stalk) side of the leaf. The eggs usually tend to be deposited at an angle in the plant tissue, and the outer ends of the eggs, which project slightly above the plant epidermis, are covered over by a deposit of white wax. The incubation period varies with the temperature: in warm weather it may be as short as two weeks, but may extend over a period up to five or six weeks in the cooler seasons or at higher elevations. The incubation period may also be prolonged by dryness, and eggs in cane cuttings may not hatch for several weeks because of dryness.

The incisions made for the reception of the eggs make way for the entrance of a "red rot" fungus, *Physalospora tucumanensis* Spegazzini (*Colletotrichum falcatum* Went). This, and fermentation of the injured tissues, cause a reddish discoloration at the oviposition site, and the infested parts of the cane may become conspicuously reddish or closely red-spotted. These "claret-colored egg spots" are characteristic of leafhopper infestation, and have served to diagnose infestations even in the absence of nymphs and adults.

The first nymphal instar is conspicuous on account of the produced head. The vertex is a trifle longer than wide, extending well in front of the eyes and wider between them than an eye. I cannot trace any transverse or discal keels. On the frons there are *two keels* (which do not meet on the vertex or elsewhere), which are rounded convexly. These do not unite at the apical margin of the frons, nor do they meet the lateral keels there. The frons exterior to these submedian keels is wide and covered with sensory organs. The second segment of the antennae is large and stout but short. I cannot trace any sensory organs. The tarsi are bisegmentate, the posterior pair being provided each with a small mobile spur.

The second and third instars are not remarkable, except that the spur lengthens, the head shortens and the usual changes take place in the thorax. The fourth instar is very close to the adult, except that the body is still covered with sensory organs and the submedian keels are still separate, not uniting at the apical margin of the frons. In this instar, the sensory organs on the antennae are very conspicuous. (Kirkaldy, 1906:278–279.)

The length of each of the five instars was found by Van Dine (1904) to range from 4 to 9 days, with an average of about 7 days each, with the entire life cycle requiring 56 days at an average temperature of about 72 degrees, or 48 days at an average temperature of 77 degrees.

Kershaw (1913:185–186) notes that the food reservoir of the alimentary canal "... enters the head. The malpighian tubes are forked distally for a considerable length, the forked and about half the single portion being lobulate, the rest smooth. The color varies from pale pink to dark purple-red."

The nymphs and adults congregate in large numbers toward the bases of the leaves. They are more active at night than during the day, and the macropterous forms are attracted readily to lights. Copulation, oviposition and dispersal or migration usually take place at night. "... when disturbed in the daytime [it] flies but a short distance, or is even unwilling to fly at all, trusting to its leaping

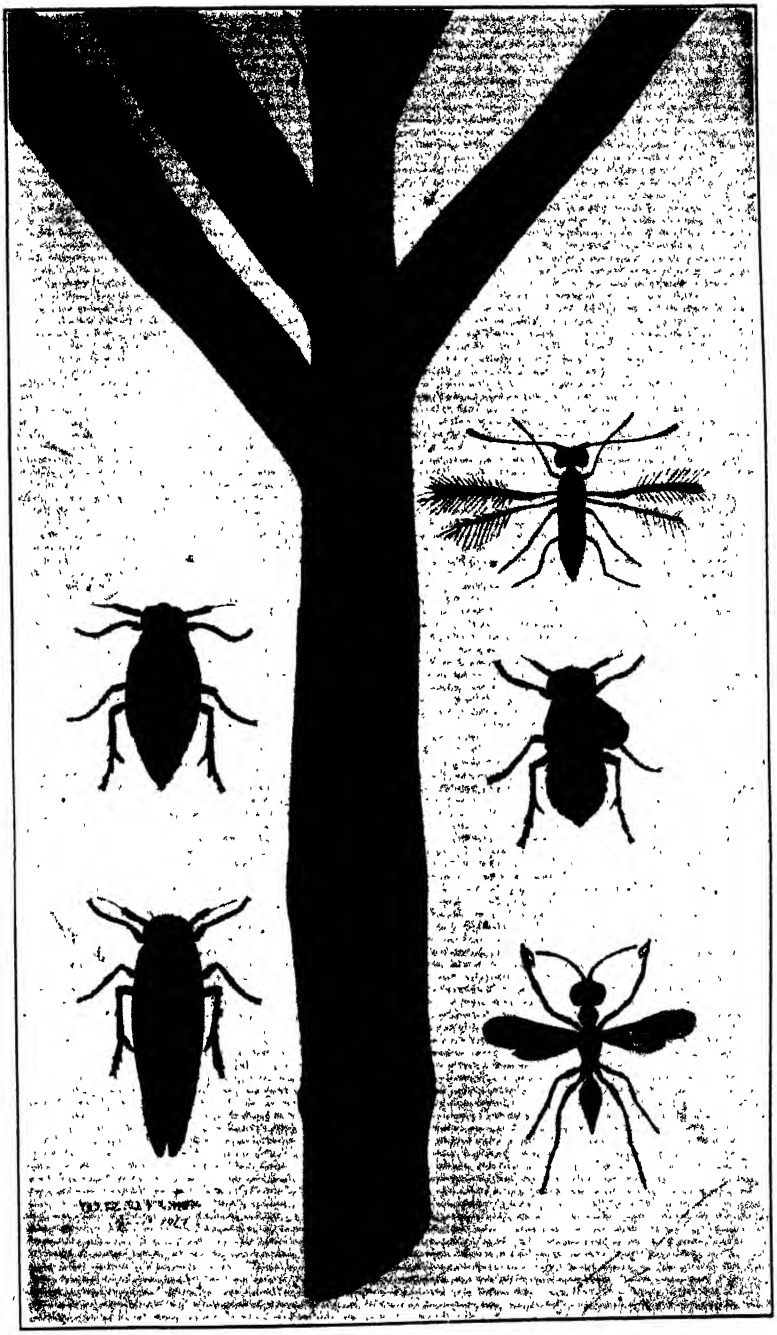

Figure 85—*Perkinsiella saccharicida* Kirkaldy, the sugarcane leafhopper, and two of its parasites. The plate shows an infested stalk of sugarcane as it appeared when the leafhopper was abundant. Short- and long-winged females on the left, the egg parasite *Paranagrus optabilis* Perkins (top right), a nymph (middle right) showing the protruding black larval sac of the dryinid parasite *Echthrodelphax fairchildii* Perkins (bottom right). (From a painting in the Experiment Station, H.S.P.A., by W. R. Potter; after Swezey, 1915.)

powers to escape, or is content to sidle round the leaf or stem out of sight, or to run backwards when threatened from the front." (Perkins, 1903:9.) "On certain occasions, however, they have been seen flying in one direction in the day time in such numbers as to form a migratory swarm, quite like that which occurs in the case of certain locusts, dragon-flies, butterflies and other insects." (Perkins, 1903:11.)

Williams (1931:122–123) describes the stridulation of the leafhopper as follows: it is an intermittent noise, "... a sort of chirping, commencing with a staccato note, followed after a short pause, by a diminuendo of short rasping strokes, the whole lasting about two seconds. In addition, the insect may produce a sort of brisk tattoo suggestive of flapping the wings against a surface. These noises were audible from a distance of about eight feet, and were heard in my room [where a number of leafhoppers were enclosed in a large jar] in the afternoon and night and also once or twice in the field at 10:40 A.M. during bright warm weather. No movement could be detected in the stridulating insects." On still evenings the stridulation of thousands of leafhoppers in canefields sounded like the approach of a rain squall.

During the cooler seasons of the year, brachypterous females are developed in numbers, whereas they are only rarely found in the warmer seasons. The brachypterous females appear to be more prolific than the macropterous forms, and, consequently, the leafhopper populations increase more rapidly in the cooler seasons and the damage is then most severe.

Because of the copious amounts of honeydew produced, molds find unusually favorable conditions for growth upon the plants, and "... in bad attacks whole fields of cane may be black with the usual black fungus, or in striking contrast, white with another species, or the black smut may be followed and overgrown with the white fungus." (Perkins, 1903:11.)

> The result of leaf-hopper attack when very severe is seen in the drying up of the leaves (from the constant sucking of their juices) before their full functions are performed. In consequence of this the joints of the stem, even at the time when they should be thickening, become on the contrary tapering and contracted, so much so sometimes that the crown topples over and is even entirely destroyed, further growth, of course, being at an end. Young cane is sometimes entirely killed out before any considerable length of stem has been produced. (Perkins, 1903:12.)

The astounding abundance of the leafhopper at the height of its development in Hawaii can be appreciated only by those men who actually had experience in the fields at that time. A sour odor hung over the fields during periods of severe epidemic. Most of the present plantation men really have no idea of, nor can they truly appreciate, the overwhelming numbers of leafhoppers which swarmed over the cane during the "leafhopper years" and the great damage caused. If undisturbed, the offspring of a single pair of leafhoppers might exceed a half billion individuals within a year.

The story of discovery, study, exploration and biological control of the leafhopper and of the development and advancement of Hawaiian entomology follow-

ing its establishment in Hawaii is an epic. To tell it fully and adequately would require a separate volume. The whole future of the economic stability of the Territory appeared at one time to hinge upon the success or failure in the control of the leafhopper. The economic foundation of Hawaii is rooted in sugar, and that foundation was rapidly dissolving in 1903 and 1904 at the height of the leafhopper attacks—only two years after the insect was first discovered damaging the cane. At a time when the tonnage of sugar produced should have been increasing, it dropped from 437,991 to 367,475 tons, or a loss of 70,516 tons in a year, because of the ravages of the leafhopper. This reduction in yield represented a loss of more than five million dollars in a single year. Some plantations were almost wiped out. "The most severely injured plantation on the Island [Hawaii] was the Hawaiian Agricultural Company at Pahala, where the Yellow Bamboo cane was the variety chiefly grown, and it proved to be more susceptible to leafhopper attack than any other variety. The damage was so extensive here that whole fields of great area were practically killed outright, and the plantation, which had a crop of 18,888 tons in 1903, was reduced to crops of 1,620 tons in 1905 and 826 tons in 1906." (Swezey, 1936:61.) With successful control, by 1940 the yield of 96° sugar for the Territory was 976,677 tons, representing a value of nearly 54 million dollars.

Inasmuch as the leafhopper has been intercepted at quarantine in Honolulu in sugarcane cuttings from Australia (eggs inserted in the stalks), it is presumed that it was by this means that the insect first gained entrance to Hawaii.

Although it was first collected in 1900, it was not until the next year that the leafhopper was reported by entomologists as attacking cane (Koebele's report in the *Hawaiian Planters' Monthly*, 21:20–26, 1902). Soon thereafter the reports of damage on various plantations throughout the islands came in rapid succession, and it was evident that the worst pest in the history of the industry had secured a firm foothold.

At that date there were no entomologists on the staff of the Hawaiian Sugar Planters' Association Experiment Station. Albert Koebele had been employed by the Hawaiian Board of Agriculture and Forestry in 1893 after his remarkable success in the biological control of the cottony cushion scale in California. He spent much of his time away from Hawaii in search of beneficial insects for introduction. At the time of the leafhopper outbreak, Dr. Perkins was employed as Koebele's assistant. The Hawaii Agricultural Experiment Station (a Federal station) had then been organized for only a couple of years but had begun entomological research with D. L. Van Dine as entomologist. The University of Hawaii had not yet been founded, and Bishop Museum did not have a department of entomology. Thus the number of entomologists working in Hawaii was small, and there were no routine entomological inspections made on the sugar plantations. With Koebele in Mexico searching for insects to control the *Lantana* weed pest, Perkins and Van Dine carried on independent research on the leafhopper after it was discovered to be a cane pest. Inasmuch as the Hawaiian Sugar Planters' Association had been subsidizing the work of Koebele and Perkins, in 1902 they

asked for the recall of Koebele to Hawaii for the purpose of concentrating his efforts on the leafhopper. Koebele returned to Honolulu early in 1904, after having convalesced at Alameda, California, from illness contracted in the tropics (malaria ?), and later (1903) having studied, at the recommendation of L. O. Howard, with O. H. Swezey, who at that time was in Ohio and had worked there on leafhoppers and their parasites under Herbert Osborn. In 1904 Koebele and Perkins went to Australia in search of parasites.

During Koebele's absence in America, Perkins had ascertained that the leafhopper (which had been determined as a genus and species new to science) was an Australian insect. In 1903 G. W. Kirkaldy and F. W. Terry were added as entomological assistants in the Territorial Board of Agriculture and Forestry.

By 1904 the losses to the sugar plantations were so great that it became essential that an adequately staffed division of entomology be established in the Hawaiian Sugar Planters' Association Experiment Station. Thus, Perkins was appointed director of the new division, with Koebele as consulting entomologist, Kirkaldy and Terry as assistant entomologists, and Swezey was brought from Ohio especially for breeding parasites and inspection work and later had charge of the distribution of parasites to plantations and the progress of their establishment and spread in the fields. Hence, while Perkins and Koebele were searching for parasites in Australia, the new Division of Entomology of the Sugar Planters' Experiment Station had an active staff in Honolulu.

Koebele and Perkins arrived in Queensland in June, 1904, and immediately discovered that the leafhopper was kept under control by a number of parasites. Cultures of some of these parasites were shipped back to Honolulu. Perkins returned to Honolulu at the end of 1904, and Koebele followed in 1905, stopping in Fiji to obtain parasites on the way, but left Hawaii to retire that summer. In the fall of 1905 Frederick Muir was employed to fill Koebele's place in foreign exploration for parasites.

The parasites which became established in Hawaii as a result of the Koebele and Perkins expedition were the following small Hymenoptera: *Paranagrus optabilis* Perkins (sent from Queensland), *Paranagrus perforator* Perkins (from Fiji), *Anagrus frequens* Perkins (from Queensland), and *Ootetrastichus beatus* Perkins (introduced from Fiji, but also found in Australia). Of these, *Paranagrus optabilis* Perkins was the most successful.

As the result of the attacks of parasites and predators, by 1907 a fairly effective leafhopper control had been established. However, damage was still caused, local outbreaks continued to occur, and although the Hawaiian sugar industry had been saved from utter disaster, further attempts were made to procure additional parasites.

Muir continued the exploration and introduction work begun by Koebele and Perkins, and the parasites sent to Hawaii by him included *Haplogonatopus vitiensis* Perkins, introduced from Fiji in 1906; *Pseudogonatopus hospes* Perkins, introduced from China in 1906; *Ootetrastichus formosanus* Timberlake, introduced from Formosa in 1916; and *Cyrtorhinus mundulus* (Breddin), introduced from Queens-

land in 1920. Of all the enemies introduced, the *Cyrtorhinus* bug proved to be the most efficacious.

In 1919 C. E. Pemberton was added to the staff as assistant entomologist and as a field assistant for Muir. When Muir was in Queensland he discovered that the *Cyrtorhinus* sucked the eggs of the sugarcane leafhopper. This bug belongs to the family Miridae, which is normally a plant-sucking group and contains many well-known and important crop pests. Pemberton studied a small lot of the bugs brought by Muir to Honolulu on June 21, 1920. He found that the bugs confined their attacks entirely to leafhopper eggs and would starve if eggs were not available. With the beneficial habits of the bugs fully ascertained, Muir and Pemberton released a few individuals in the fields of the Ewa Plantation on July 19, 1920. In 1920 Pemberton went to Fiji, where Muir had previously found the bug without having discovered its egg-sucking habits, and made several shipments of bugs to Honolulu in the fall of that year.

Cyrtorhinus quickly became established and widespread, and it reached Molokai and Maui without having been purposely introduced to those islands. By 1923, the bug was generally distributed over all sugarcane areas in the islands and the leafhopper was everywhere under control and even difficult to find. The leafhopper has remained under control ever since, and whenever there is a local upbuilding of leafhopper populations, the subsequent increase of *Cyrtorhinus* reduces the numbers of leafhoppers. It is now frequently difficult to obtain leafhoppers for exhibition or classroom work without considerable search.

So successful has been the control of the leafhopper by *Cyrtorhinus* that it is considered that had entomologists of the Hawaiian Sugar Planters' Association Experiment Station found the bug early in their search for parasites it alone could have accomplished complete control, and none of the other introductions would have been necessary. Large sums of money could have been saved by such a fortunate discovery, not only from the expenses of extensive field work, but also in the earlier control of the leafhopper. Had there been an adequate museum collection of Pacific insects in Honolulu in those early days, the task of finding parasites and predators would have been aided considerably. As it was, the field searchers went abroad with meager information, but luck was with them and they accomplished what they set out to do with marked success. Confusion had arisen soon after the appearance of the leafhopper in Hawaii because it had been misidentified as a Javanese species by a worker at the National Museum. Had the error not been quickly corrected by Kirkaldy, who had access to the extensive collections at the British Museum, much delay and additional expense probably would have resulted.

This leafhopper is capable of transmitting the dreaded Fiji disease of sugarcane. A disaster might fall at any time in Hawaii should that terrible disease become established here.

The story of the biological control of the sugarcane leafhopper in Hawaii belongs high in the annals of entomological history.

For bibliographies pertaining to the sugarcane leafhopper, see Swezey, 1936: 98–100, and Metcalf, 1943:137–141.

Genus **PEREGRINUS** Kirkaldy, 1904:175

This is a monotypic genus. In our fauna it most closely resembles *Perkinsiella*, but the genotype is a more slender insect which does not have the expanded antennal segments that make *Perkinsiella* so distinctive. Brachypterous and macropterous forms occur in both sexes. For a detailed list of references to the genus, see Metcalf's world catalogue (1943).

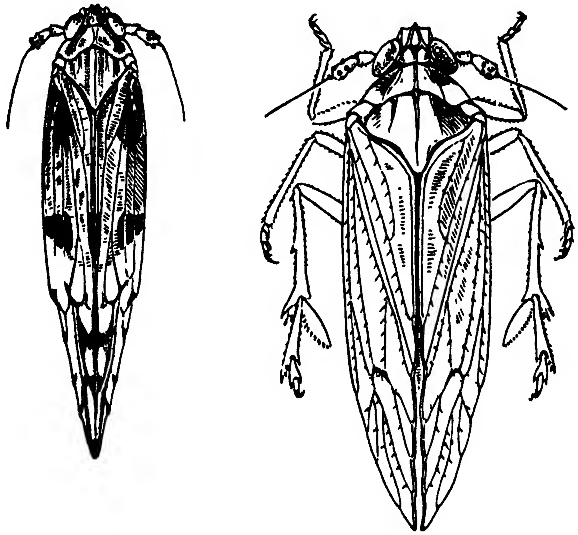

Figure 86—*Peregrinus maidis* (Ashmead), the corn leafhopper, left; *Liburnia paludum* (Kirkaldy), right, drawn to one-third larger scale than *Peregrinus* (this is a macropterous female, but most Hawaiian specimens are brachypterous). (Abernathy drawings.)

Peregrinus maidis (Ashmead) (figs. 86, 87, 88).

Delphax maidis Ashmead, 1890:323, figs. *a–g*.

Peregrinus maidis (Ashmead) Kirkaldy, 1904:176. Genotype.

For detailed synonymy and a bibliography of about 140 titles, see Metcalf's catalogue (1943:252–256).

The corn leafhopper.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii.

Immigrant. Tropicopolitan, but extending into the temperate zones in North America, Australia and Africa; described from Florida. It may be a native of Malaysia, but I do not believe that its place of origin is known within narrower limits. Specimens were collected in the Territory by Perkins in 1892, but there is reason to believe that the species was established in the islands about 1880.

Hostplant: corn. Although the leafhoppers may occasionally be found on sorghum, sugarcane, Job's tears and perhaps on other grasses, such occurrences are apparently accidental, for in Hawaii they appear to be able to breed successfully

only on corn. Muir (1917:147) noted that he found this species breeding on native grasses in the Malay Archipelago and in the Philippines.

Parasites and predators: *Paranagrus optabilis* Perkins, *Paranagrus osborni* Fullaway (this is either the same species as *P. optabilis* or is a difficult-to-separate ally of that species), *Anagrus frequens* Perkins (Hymenoptera: Mymaridae) and *Ootetrastichus beatus* Perkins (Hymenoptera: Eulophidae) parasitize the eggs. *Haplogonatopus vitiensis* Perkins (Hymenoptera: Dryinidae) parasitizes the nymphs and adults. The known predators in Hawaii include spiders, the voracious ant *Pheidole megacephala* (Fabricius) which eats both eggs and nymphs, coccinellid beetles including *Coelophora inaequalis* (Fabricius), the bug *Zelus renardii* Kolenati, the mirid bug *Cyrtorhinus mundulus* (Breddin), the earwig *Chelisoches morio* (Fabricius), and chrysopid lacewings.

In addition to these, the predaceous mirid bug, *Cyrtorhinus lividipennis* Reuter (a near relative of the sugarcane egg-sucking bug), was imported to feed on the eggs, but it failed to become established. This insect should be reimported with every effort made to obtain its successful establishment here.

Figure 87—*Peregrinus maidis* (Ashmead), the corn leafhopper.

Peregrinus maidis is a serious pest of corn, and the damage resulting from infestation may cause crop failure. Populations of the leafhoppers may increase rapidly to great numbers, and the sucking of the plant juices causes a wilting of the plants which resembles drought wilt. Also, the lesions caused by feeding and oviposition make way for fungus infection. Moreover, the leafhopper is the vector for the serious corn mosaic ("yellow stripe") disease.

Corn mosaic, a virus disease, is the most destructive of the enemies of corn in Hawaii. Kunkel (1921:45–46) states that

> Under conditions such as exist in Hawaii it is one of the most destructive corn diseases known to pathologists.... Mottling or striping of the leaves and dwarfing of the plant are the most striking symptoms of corn mosaic. The leaves, leaf sheaths and rind of the stalk are mottled or striped with areas of lighter green color. In certain instances the color in the dark green areas is more intense than is common for normal healthy tissues of healthy plants. This heightens the contrast between the light and dark green areas. The shade of green in the lighter areas varies considerably in different plants and during different stages of the disease.

Kunkel also notes that the dwarfing symptom is even more striking than the striping and mottling and that all infected plants are more or less dwarfed, and he says (p. 47),

Plants that become diseased while young are severely dwarfed, even in the more resistant varieties. Plants attacked before they reach the tasselling stage never produce good ears of corn. If the plant is several feet high before contracting the disease the dwarfing will be less marked. Even in cases of extreme dwarfing the disease does not seem either to hasten or delay the time at which plants mature. Diseased plants show their silk and tassel at the same time as healthy ones. They frequently produce one or more small nubbins. The disease does not have much effect on the yield of plants that are attacked only shortly before they reach maturity. Mosaic has not been observed to kill young plants outright. Mature diseased plants die and dry up earlier than do normal ones.

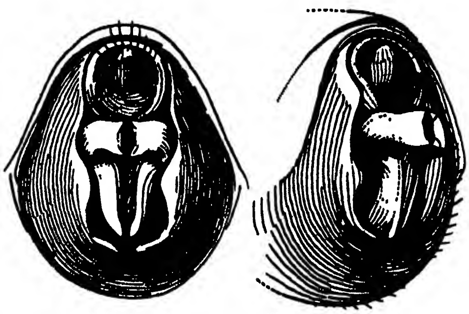

Figure 88—*Peregrinus maidis* (Ashmead). Two views of the male pygophore. (After Kirkaldy, 1907.)

The control of mosaic has centered around the introduction and breeding of resistant varieties of corn. Control of the leafhopper by biological or chemical means does not appear to result in successful control of the disease, for a small population of infected leafhoppers can infect a field of corn even though a large leafhopper population is prevented from developing. However, this should not discourage future introduction of promising leafhopper parasites and predators.

The corn leafhopper is a lowland insect, and corn grown at elevations above 2,000 feet is rarely attacked by the hoppers. Corn grown at high elevations is free from mosaic.

Fullaway (1918) has published descriptions of the early stages of the insect, and the following paragraph of data has been abstracted from his paper.

The 0.8 mm. long, cylindrical, curved, somewhat pyriform, pearly white eggs are deposited principally in the midrib of the upper sides of the leaves, but sometimes in the stalk, in cavities made by the saw-toothed ovipositor. From one to four eggs are placed (head, or narrow end, outward) in each cavity which is marked externally by a scar and a little whitish wax. They are often laid in regular rows, sometimes double rows, a slight distance apart. The eggs hatch in nine days in summer, and the hatching time is retarded in cooler weather and by dryness. Up to 300 or more eggs may be laid by one female at rates as high as

more than 50 per day. About 200 eggs per female is considered an average number. The durations of the nymphal instars are as follows: I, 3 to 4 days; II, 2 to 4 days; III, 3 to 4 days; IV, 3 to 4 days; V, 4 to 5 days. Wing pads appear in the third instar.

The adults of both sexes may be brachypterous or macropterous, but the long-winged forms have been found to be about twice as abundant as the short-winged forms. Also, females are more abundant than males. The adults will live for at least a month under favorable conditions. The life cycle in the lowlands in the summer is about a month. Thus, several generations of leafhoppers may develop on a corn crop before it is harvested, for it requires about 100 to 120 days for corn to mature here. The hoppers usually attack the corn several days after it appears above the ground, and new immigrants arrive continually. The accumulation of leafhoppers on the corn plant is rapid. As many as 50 adult hoppers have been counted on a single plant in a new field adjacent to older plantings. As many as 1,000 eggs per leaf on a 12-leafed, two-month-old plant have been observed. The abundance of the hoppers can most easily be demonstrated by bending the leaves away from the stalk and observing the masses of individuals that congregate on the inner sides near the leaf bases where they are protected by the proximity of the leaf base to the stalk.

The abundance of honeydew produced affords a favorable pabulum for extensive growth of molds and attracts numbers of insects seeking sweets.

Genus **LIBURNIA** Stål, 1866

Sogata Distant, 1906.

This genus, which contains about 60 forms, is the second largest of the family, being outnumbered by *Nesosydne* only. It is a difficult assemblage of small leafhoppers. It is nearly cosmopolitan in distribution, but the largest number of species has been recorded from the Indo-Pacific regions. A detailed bibliography of the genus and its species is supplied by Metcalf's 1943 world catalogue, which should be consulted for details.

A single immigrant species occurs in our fauna, and for many years it was placed with the similar-appearing species assigned to the genus *Kelisia.* This one species is not very different from our *Kelisia* species, and it cannot be separated on the basis of characters used in keys in certain published reports consulted. Muir and Giffard (1924:12) noted that "This genus is a convenient home for a certain number of species with weak and uncertain generic character, which, if placed in other genera, break down their characters." I have found the non-vittate antennae in combination with the structures of the male terminalia to be the most reliable characters for the separation of *Liburnia paludum* from our *Kelisia* species.

Liburnia paludum (Kirkaldy) (figs. 86; 89, a).
Kelisia paludum Kirkaldy, 1910:579. Muir, 1917:310, 330, pl. 5, figs. 18, 18a.
Sogata paludum (Kirkaldy) Muir and Giffard, 1924:13, pl. 6, figs. 134, 135.
Liburnia paludum (Kirkaldy) Metcalf, 1943:366.

Kauai (?), Oahu (type locality: Waikiki, Honolulu), Molokai, Lanai (?), Maui (?), Hawaii (?), Laysan, Pearl and Hermes Reef, Midway, Kure (Ocean Island).

Immigrant. A widespread Pacific species recorded from Samoa, Fiji, Australia, Java, the Philippines, Ceylon and Jamaica and presumably of Indo-Malayan origin although originally described from Hawaii.

Hostplants: *Herpestis monnieria, Juncus,* "sedge."

Parasites: *Aphelinoidea xenos* Timberlake (Hymenoptera: Trichogrammatidae) and *Anagrus frequens* Perkins (Hymenoptera: Mymaridae) on the eggs; *Haplogonatopus vitiensis* Perkins and *Echthrodelphax fairchildii* Perkins (?) (Hymenoptera: Dryinidae) on the nymphs and adults.

This is essentially a lowland form which apparently usually frequents swampy or damp areas. Only a few macropterous Hawaiian individuals have been seen, but large numbers of brachypterous examples have been collected here.

Muir (1917:330) has called attention to the confusing differences in the color of this species in different localities. All, or nearly all, of a large series from many localities in Hawaii are pale. A large series from Samoa is very dark, with the metanotum black on some. Also, the Samoan specimens are generally smaller. Since this text was written, a few long-winged males have been taken at a light trap at Pearl Harbor (November, 1947). These were considered at first to represent a new immigrant, for they are the dark form such as is found in Samoa. The genitalia appear similar in the two forms, however. Further work on this complex is required. The dark form may be a wet-season color variant

Genus KELISIA Fieber, 1866

This is one of the larger genera of Delphacidae. It is cosmopolitan in distribution and contains fifty-odd forms. A large mass of literature has been assembled on the genus, and Metcalf's world catalogue should be consulted for detailed references.

In the Hawaiian fauna, this group can be separated easily from all the genera of the Delphacini excepting the single immigrant species of *Liburnia* which was assigned originally to *Kelisia.* The color pattern of the antennae and the structure of the male terminalia will serve to separate the species of the two genera now known in our fauna, but the generic differences need amplification and strengthening.

Muir (1917:310) said that the Hawaiian members of this genus "have the face slightly broader and the sides more arcuate than in the type species."

The five forms known from Hawaii have been considered possible immigrants by some authors, but there appears to me to be reason for considering them endemic.

I believe that the group has gained entrance to the Hawaiian Islands relatively recently, geologically speaking, as compared with our other native delphacids. I do not doubt that further collection and study will result in the discovery of additional new species. The known forms are closely allied, and some difficulty may be encountered when naming specimens, but, as the drawings show, the male genitalia are distinctive.

These insects differ from our other native Delphacidae in habit because they are attached to grasses. None of the other Hawaiian delphacids are grass-feeders.

Long-winged females of *Kelisia eragrosticola, sporobolicola* and *swezeyi* have been seen.

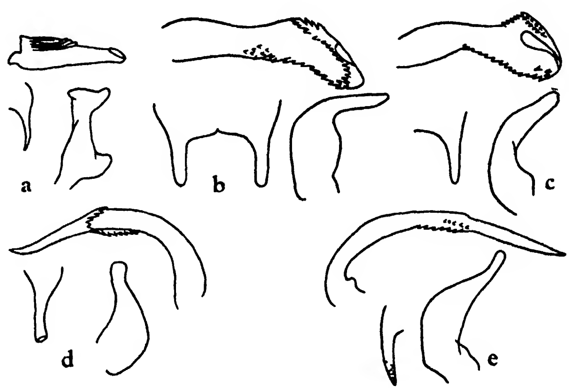

Figure 89—Details of the male genitalia of some delphacids. Each group of figures shows the aedeagus (top), anal spine (left), and a genital style (right). Figure **b** includes a rear view of both anal spines and shows the concave hind edge of the anal segment. All drawings made from balsam mounts; setae omitted. **a,** *Liburnia paludum* (Kirkaldy); **b,** *Kelisia eragrosticola* Muir; **c,** *Kelisia emoloa* Muir; **d,** *Kelisia sporobolicola* Kirkaldy; **e,** *Kelisia swezeyi* Kirkaldy.

Key to the Hawaiian Species of Kelisia

1. Granules of tegminal veins darker than veins and conspicuous or comparatively conspicuous 2
   Granules of tegminal veins not distinctly darker than veins, usually inconspicuous or obsolete 3

2(1). Tegmina so abbreviated that three or four abdominal tergites (exclusive of pygophore) are left exposed; lateral carinae of pro- and mesonotum conspicuously oblique and not nearly in line longitudinally; pygophore of female entirely pale .... **sporobolicola** Kirkaldy.
   Tegmina more elongate so that only two or two and a part of a third abdominal tergites are exposed; lateral carinae on pro- and mesonotum not very oblique and nearly in line longitudinally; anal angles of pygophore of female conspicuously dark adjacent to anal segment .... **swezeyi** Kirkaldy.

3(1). Anterior contour of vertex, as seen from directly above, broadly and rather flatly arcuate, distance across lateral carinae there subequal to distance across basal angles, and latter distance subequal to median length; genital styles of male not strongly bent, only slightly sinuate on their outer edges........**sporobolicola immaculata** Muir.

Vertex comparatively pointed or roundly pointed, distance across carinae there less than basal breadth across basal angles, and latter distance less than or subequal to median length; genital styles of male strongly and conspicuously bent laterad or dorso-cephalad or both....... 4

4(3). Frons with areas between carinae darker than carinae, sometimes rather strikingly contrasted, especially at front of vertex............... ......**eragrosticola** Muir.

Frons entirely pale..........................**emoloa** Muir.

Kelisia emoloa Muir (fig. 89, c).

Kelisia emoloa Muir, 1917:311, pl. 5, figs. 19, 19a.

Endemic. Oahu (type locality: Palolo Valley).

Hostplant: *Eragrostis variabilis* ("emoloa").

Kelisia eragrosticola Muir (figs. 55; 89, b).

Kelisia eragrosticola Muir, 1919:85, pl. 4, fig. 2.

Endemic. Oahu, Maui (type locality: Iao Valley).

Hostplant: *Eragrostis variabilis.*

Kelisia sporobolicola Kirkaldy (fig. 89, d).

Kelisia sporobolicola Kirkaldy, 1910:578. Muir, 1917:310, pl. 5, figs. 21, 21a; 1919:86, pl. 4, fig. 13; 1921:509.

Endemic. Kauai, Oahu (type locality: Honolulu), Maui, Hawaii.

Hostplants: *Eragrostis atropioides, Sporobolus virginicus, Vincentia angustifolia.*

Predator: *Cyrtorhinus mundulus* (Breddin) (Hemiptera: Miridae) has been recorded feeding upon the eggs.

What is apparently the type mount (a card containing three specimens) is now in Perkins' collection at the Bishop Museum. It bears the locality label "Honolulu XI.1903 R.C.L.P.," Kirkaldy's manuscript name "maritima" written on a slip of paper (torn, not cut, out of a larger sheet), and "? are these the types of K. sporobolicola K. R.C.L.P." I have placed this material in the type collection at the Bishop Museum.

Kelisia sporobolicola immaculata Muir.

Kelisia sporobolicola variety *immaculata* Muir, 1921:509.

Endemic. Hawaii (type locality: Kilauea).
Hostplants: *Deschampsia australis, Vincentia angustifolia.*
Parasite: *Anagrus frequens* Perkins (Hymenoptera: Mymaridae) in the eggs.

Kelisia swezeyi Kirkaldy (fig. 89, e).
Kelisia swezeyi Kirkaldy, 1910:578.

Endemic. Kauai, Oahu (type locality: Kalihi, Honolulu).
Hostplants: *Eragrostis variabilis, Gahnia* ("coarse sedge" ?).

Genus TAROPHAGUS, new genus

Metcalf (1943) lists about 35 species under *Megamelus,* but it is obvious that the species of this assemblage belong to more than one genus. Our taro leafhopper is not congeneric with the genotype, *Megamelus notula,* and it must be removed from that genus. There appears to be no genus in which to place it, and a new one must be erected to receive it.

Megamelus is well developed in Europe and North America, and it has extended its range to South America. It does not appear to have invaded Africa or the Orient. The eight Pacific species now assigned to it must be removed. I would assign the well-known taro leafhopper and *M. proserpinoides* Muir, 1917 (Philippines), and *M. persephone* Kirkaldy, 1907 (Queensland), to the new genus and suggest that the following species may belong here; further study and additional

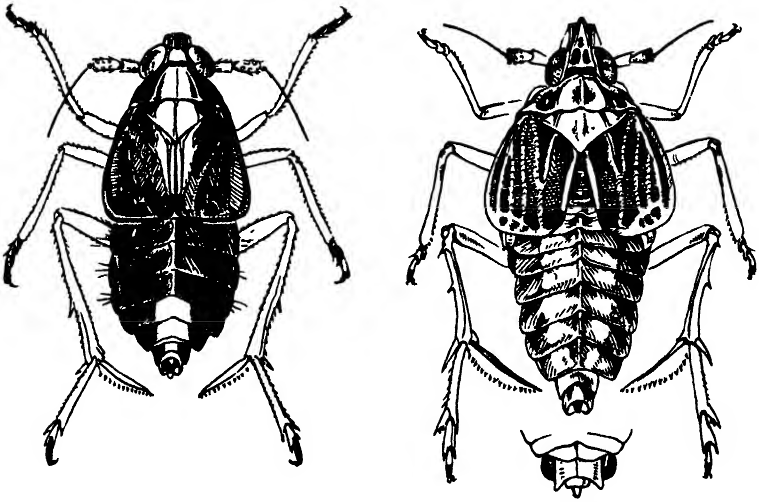

Figure 90—*Tarophagus proserpina* (Kirkaldy), the taro leafhopper, brachypterous female, left; *Megamelus angulatus* Osborn, the water lily leafhopper, brachypterous female, right, with sketch of male pygophore from above to show inflated sides. (Abernathy drawings.)

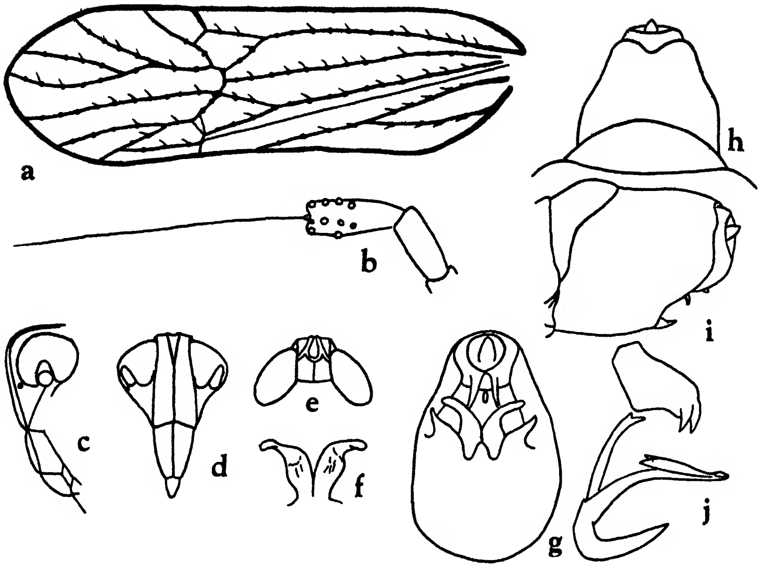

Figure 91—Diagrams of features of *Tarophagus proserpina* (Kirkaldy): **a**, fore wing of a macropterous male paratype (the venation is subject to variation); **b**, antenna; **c**, outline of front of head from side, male paratype; **d**, the same, full front view; **e**, the same, dorsal view; **g**, ventral view of pygophore; **h**, the same, dorsal view; **i**, the same, lateral view; **j**, lateral view of anal segment and aedeagus.

material of these five species are needed before conclusions can be reached regarding them: *M. geranor* (Kirkaldy) Muir, 1917 (Queensland); *M. kaha* (Kirkaldy) Muir, 1917 (Queensland); *M. leimonias* (Kirkaldy) Muir, 1917 (Queensland); *M. muiri* Metcalf, 1943 (*albicollis* Muir, 1917) (Philippines); and *M. sponsa* Kirkaldy, 1907 (Queensland). I have seen also new species which belong to *Tarophagus*.

The most striking differences between *Megamelus* and *Tarophagus* are displayed in the male terminalia. *Megamelus* has the sides of the pygophore characteristically inflated (as shown in my illustration) and the structure of the appendages and their arrangement are quite distinct. Muir (1926) has illustrated the genitalia of some *Megamelus* species, and his drawings may be consulted for a clear picture of the *Megamelus* type of terminalia. My sketches of *proserpina* illustrate the terminalia of the genotype of *Tarophagus*. The carinae are not strongly protuberant on the apex of the vertex of the head on *Tarophagus*, but they are strongly protuberant on *Megamelus*, and the vertex is longer on *Megamelus* as the drawings show. The appendages of *Tarophagus* are proportionately longer and more slender than those of *Megamelus*. For example, on *Tarophagus* the hind tibiae have the inner or shortest tibial length (excluding the terminal expansion and spines) as long as the entire tarsus. On our *Megamelus*, however, the corresponding tibial length is not as long as the two basal tarsal segments. The

head of *Tarophagus* is loosely compacted to the pronotum as compared with *Megamelus* on which the hind edges of the eyes seem almost to be shallowly inserted into the pronotum, as compared with *Tarophagus*. The wing venation of the genotype of *Tarophagus* is as illustrated. When series of species of each genus are available, other characters of generic importance may be drawn up, but the differences pointed out here are sufficient for our present purpose.

Genotype: *Megamelus proserpina* Kirkaldy.

I am indebted to Mr. R. G. Fennah for concurrence of opinion regarding the establishment of the new genus.

Tarophagus proserpina (Kirkaldy), new combination (figs. 46, a; 90; 91, a–j).
Megamelus proserpina Kirkaldy, 1907:147, pl. 10, figs. 5–7; pl. 12, figs. 19–21.

The taro leafhopper.

Kauai, Oahu, Hawaii.

Immigrant. A widespread species found in Java, the Philippines, Guam, Amboina, Australia, New Hebrides, Fiji (type locality: Suva), Tonga, Niue, Samoa, the Society Islands and elsewhere in the Pacific. This species was first found in the Territory in 1930 by Swezey and Fullaway, who reported it as being abundant at Waianae, Oahu.

Hostplant: *Colocasia esculenta* (taro).

Parasites: *Haplogonatopus vitiensis* Perkins (Hymenoptera: Dryinidae) attacks nymphs and adults; *Ootetrastichus megameli* Fullaway (Hymenoptera: Eulophidae) attacks the eggs.

Predators: *Cyrtorhinus fulvus* Knight, and *Cyrtorhinus mundulus* (Breddin) (Heteroptera: Miridae) suck the eggs; the former is the more important predator on this leafhopper.

A considerable effort was made by the Board of Agriculture and Forestry in attempting to eradicate this species when it was first discovered. The torch was applied to rather large areas of taro, but in spite of the control efforts, the species spread about the island.

Mr. Fullaway made a trip to the Philippines to obtain parasites and predators and recorded some life history notes in his 1937 report (pp. 405–406) on the species. The following résumé is from his report:

The eggs, which are less than 1 mm. in length, are pearly white, spindle-shaped with pointed ends and are deposited, usually in pairs, in cavities hollowed out in the taro tissue. They hatch in 8 to 9 days. The adult stage is reached in 13 days, after four molts at 3- to 4-day intervals. The eggs are fully developed in 3-day-old adults. Most individuals are brachypterous, but long-winged forms are said to be found occasionally in winter.

Large colonies of leafhoppers may build up on irrigated taro.

Genus **MEGAMELUS** Fieber, 1866

See the commentary under *Tarophagus* for notes on this genus.

Megamelus angulatus Osborn (fig. 90).
Megamelus angulatus Osborn, 1905:374.

The water-lily leafhopper.

Oahu.

Immigrant. An eastern United States species, described from Delaware. First reported in the Territory by Fullaway from examples collected at Aiea, Oahu, in 1941.

Hostplant: *Nymphaea* water lilies.

Parasite: *Polynema ciliata* (Say) (Hymenoptera: Mymaridae) attacks the eggs. This parasite was brought to Honolulu from Michigan in 1941 by Fullaway and it quickly established itself on local leafhopper colonies.

This leafhopper may at times cause concern to growers of water lilies, but complaints have not heretofore been common. It has been wrongly called *Megamelus davisi* Van Duzee in some Hawaiian literature.

Family **FLATIDAE** Spinola, 1839

A single immigrant species represents this family in Hawaii. The group is most conspicuously developed in the continental tropics and adjacent islands, and many of the species are large and showy. They are considered the most highly evolved of the Fulgoroidea.

The one species now in our fauna can be confused with no other local group. Its vertically held, broad, subtriangular tegmina which have granulate clavi, together with the characters outlined in the family key, readily will distinguish the family.

Subfamily FLATINAE

Genus **SIPHANTA** Stål, 1860

This genus has its headquarters in Australia.

Siphanta acuta (Walker) (fig. 92).

Poeciloptera acuta Walker, 1851:448.

Phalainesthes schauinslandi Kirkaldy, 1899:359. (Genotype of *Phalainesthes*). Synonymy by Kirkaldy, 1902:117.

Kirkaldy, 1907:100, pl. 3, figs. 2, 4; pl. 6, figs. 13–14, 17–20.

The torpedo bug.

Kauai, Oahu, Molokai, Lanai, Maui, Hawaii.

Immigrant. An Australian species which has been artificially spread elsewhere, including Tasmania and New Zealand. It was established in Hawaii prior to 1898, or thereabout. "By 1900 it had become so extremely numerous, that in some of the forests on Oahu it was actually destroying large numbers of certain native trees, besides being injurious to coffee and other cultivated plants. A Proctotrupoid egg-parasite (*Aphanomerus pusillus*), introduced by Koebele in 1904, has done excellent service in many localities in diminishing the numbers of this pest. In wet districts it frequently is destroyed by a parasitic fungus." (Perkins, 1913:cciv.)

Hostplants: *Acacia, Cheirodendron, Citrus,* coffee (at one time considered a pest on this plant), *Coprosma, Eucalyptus,* guava, *Metrosideros, Moraea iridioides, Rubus, Styphelia* (*Cyathodes*), sumac, *Myrsine* (*Suttonia*), *Tetraplasandra* and many other kinds of plants.

Parasites and predators: *Chrysopa microphya* McLachlan (Neuroptera) preys upon the nymphs; *Aphanomerus pusillus* Perkins (Hymenoptera: Scelionidae) attacks the eggs; an undetermined fungus; *Nesomimesa antennata* (Smith) (Hymenoptera: Mimesidae) stores its nests with paralyzed individuals; certain coccinellid beetles prey upon the eggs.

This common, widespread hopper, called "torpedo bug" because of its great leaping powers, is one of the most characteristic members of our introduced fauna. The hind edges of the green, truncated tegmina are edged with pink. The life history in New Zealand has been reported upon by Myers (1922:256).

The eggs are deposited in sub-circular masses about 5 mm. in diameter on the leaves of plants. The egg-mass is slightly convex because the eggs in the middle of the mass are placed more nearly upright than those along the margins. The entire clutch of up to more than 100 eggs is glued together and partially covered by a cement.

Figure 92—*Siphanta acuta* (Walker), the torpedo bug.

The green and red nymphs of the five instars have been adequately described and discussed by Myers. The young nymphs prefer to feed upon leaves, but older ones feed upon stems.

They are very inactive, sitting for hours with their beaks applied to the stem. Occasionally an abdomen commences to vibrate—the vibrations pass gradually to an up-and-down thrashing—and at the moment of greatest amplitude of the movement, on the summit of an up-stroke, a perfectly spherical bead of honeydew, almost as big as the width of the abdomen at its tip, is exuded, and rapidly jerked away between the tufts of filaments which lie on each side of the anal extremity, and which are parted for the purpose. The younger instars are less forcible in this process, and frequently show a bead of honeydew held by the caudal filaments

long after it has left the body.... All of the nymphs have a peculiar habit of swaying rhythmically from side to side—either when stationary or during the act of walking slowly. ... The fifth instar nymphs can jump as far as 2 ft. The adult plant-hopper, if it jumps at all, almost always spreads its wings while in the air.... The older nymphs are often surrounded by a mealy halo of white pruinose material from the filaments, which are easily detachable. The formation of such circles, between which and the body itself of the insect is always a clear space, would be best explained by the supposition that the nymphs move round frequently without changing to a like extent the position of the rostrum. (Myers, 1922:262–263.)

At Kula, Maui, in 1944, I saw 15 adult specimens on 10 inches of stem of *Moraea iridioides*. Their peculiar motion reminds one of a dance—a bug "hula."

Kershaw (1913:175) published a detailed, illustrated study of the alimentary canal of this species. He reported that the adults live about two months in Hawaii, and that the eggs hatch in between 10 and 20 days.

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